Public Works Engineers' Yearbook

1938

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Including the Proceedings of the

1937

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FOREWORD

For many years the officials of local, state, and federal governments charged with responsibility for public works activity have met annually to share their experiences and to cooperate in seeking solutions to their common problems, and annually have given publication to the proceedings of those meetings. The 1937 Public Works Congress, held in Atlanta, Georgia, in October, was the first of those conferences to be held under the sponsorship of the American Public Works Association, the organization established on January 1, 1937, by the formal consolidation of the American Society of Municipal Engineers and the International Association of Public Works Officials.

Earlier volumes of the Public Works Engineers' Yearbook have been restricted in content to the prepared papers and impromptu discussions presented at the annual Public Works Congress. With the intention of increasing its usefulness the present volume has been extended to include, in addition, a comprehensive review of significant events and developments in the public works field during the year 1937. As a consequence of this extension of the scope of the Yearbook, the present volume is nearly twice as large as its immediate predecessors. The book's contents can be considered to consist of two major elements, a review and appraisal of developments significant to an official carrying public works responsibilities and a more detailed discussion of selected problems of current interest. This latter part corresponds closely to the subjects given consideration at the 1937 Public Works Congress.

FRANK W. HERRING
Executive Director

Chicago, Illinois
February, 1938

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PUBLIC WORKS IN 1937:

A REVIEW OF EVENTS AND DEVELOPMENTS

PUBLIC WORKS ADMINISTRATION

Personnel Administration

ROLLAND D. SEVERY
Public Administration Service

IN 1937 civil service legislation reached an all-time high mark. In fact, more progress has been made during 1937 than in the preceding twenty-five years. Five states, three counties, and twenty-eight cities adopted comprehensive merit systems during the year. The result is that 1937 ended with more than eight hundred and fifty governmental jurisdictions in the United States operating under civil service laws.

The expansion has been led by the states of Arkansas, Tennessee, Connecticut, Michigan, and Maine, which have adopted state civil service systems and established central agencies for their administration. Public support has continued to grow and is bringing other jurisdictions closer to the adoption of the merit system. New legislative enactments and strengthening of existing civil service have become vital political issues in many localities. The year 1938 should see an increasing number of governmental units ban the spoilsman with his inevitable corruption and inefficiency.

This expansion of civil service has not been confined solely to state governments but is also to be noted in local jurisdictions. Merit systems were adopted or extended in a number of cities throughout the country. South Dakota has authorized the establishment of civil service in all cities in all departments of government. Kansas and North Dakota have legislated similar measures for their larger cities. Knoxville, Tenn., Wheeling, W. Va., and Tucson, Ariz., are other cities that will soon have civil service for most of their employes. Los Angeles has placed important department heads under civil service, including the city engineer, health officer, police and fire chiefs, and general managers of several departments.

Eleven cities and one county in New Jersey voted on November 2 to place their employees under the existing state-wide civil service system. The voters of Akron, Ohio, approved a charter amendment

extending the municipal civil service. The cities of Minneapolis, Fort Worth, and Seattle, among others, are overhauling existing systems in line with more modern techniques and objectives. In a census of merit systems completed late in 1937 by the Civil Service Assembly of the United States and Canada, it was revealed that besides the federal government, fourteen states, more than six hundred and sixty cities, and approximately one hundred and seventy counties employ their personnel on a merit basis.

The trend toward increased efficiency in government has become more apparent with an increased awareness of a mounting public debt. Public attention was again focused on government early in the depression in the interest of economy and more recently because of the recruitment of extra personnel in large numbers.

It is highly significant that there has been a change in emphasis in the movement for better personnel methods. Whereas in the long history of civil service reforms it was usually outside groups which pressed for reform, the newer tendency has grown from within. Changed from the old concept of protection from the spoilsman are the newer principles of a career in government. The development of a career is of vital importance to persons in the service and thus we find a more comprehensive approach recognizing deficiencies in the older systems. It will only be through the cooperation of administrative operating officials such as a public works officer that a smooth-working personnel program can be carried out in any jurisdiction.

Public Works Endorsement

Aside from the general expansion of the merit system on a broad front, the achievements of 1937 in the field of personnel administration as applied to the public works field can be recounted only too easily. The most satisfactory thing that can be said is that the needs are becoming more apparent. Deficiencies in the manner of handling personnel problems are becoming crystallized. As these needs and deficiencies receive more attention from public works officials, a more healthy situation will result.

Recognizing the benefits to be gained from adoption of the merit system, the American Public Works Association at its convention in Atlanta in 1937 spent considerable time discussing the personnel problem. A resolution was adopted strongly endorsing the application of the merit system of personnel administration in government

services and recommending that steps be taken to secure that objective.

It is to be hoped that the Association's recognition of personnel problems and its pledge to cooperate in securing the desired objective will result in considerable thought during the coming year and more tangible recommendations and constructive suggestions at the next convention.

Objectives

The most pressing personnel problem arises from the inability of the public service to retain competent employees in competition with private industry. It is suggested that this problem can be solved by the adoption of the following policies:

1. Providing an attractive career in the public service with the opportunity for promotion, salary advancement, and eventual retirement with a financial competence.
2. Providing for the removal from the service of employees who perform unsatisfactorily, and for any other appropriate disciplinary actions.
3. Recognizing the necessity for the establishment of a thoroughly business-like personnel system administered by a central personnel agency or public works department personnel officer.

A career in government service will become attractive only when it is possible to induce the best persons available to compete for all positions in the public works department; when salary and wage plans are developed which reflect cost of living standards as well as relative rates in private and other public employment and which assure equal pay for equal work; when transfers, salary increases, recognition and other rewards are based upon demonstrated performance and capacity; when the tremendous value of in-service training is more completely recognized and developed by improving the instruction methods of foremen and other supervisory officials and by sponsoring continuing training programs.

The Arkansas civil service act of 1937 incorporates a most progressive provision granting department heads the necessary power of dismissal subject to the right of an employee to present his side of the case. The tendency has been with most public works officials and other public officers to fail to make many needed dismissals either from lack of courage or because they improperly place the interest of the individual before the good of the service. In this

recent legislation the civil service board is not given the power of reinstatement. This power, together with judicial review by a court of record, or interference by a city council or board of public works, inevitably harms the prestige of the administrator, creates permanent problems with reinstated employees, and in general demoralizes an entire service. In the case of Arkansas the personnel officer is charged with the responsibility for investigating dismissals. If dismissals are found to be unjust, hearings are granted which serve to bring political or capricious removals to the public knowledge. The findings and recommendations of the persons or board conducting the hearing are transmitted to the department head for further consideration of action taken. If dismissals by administrative officers are found on investigation to be unjust, then it is time to hire a different officer, not to aggravate the situation by interfering with the management process through dealing with reinstatements of individual employees. If employees entered the public service through highly competitive recruitment, there would be little concern over removals. The place to concentrate attention is on who gets in the front door, not on who is to be let out the back door.

It has been demonstrated that a personnel agency or departmental personnel officer can serve the public works department by classifying positions, preparing salary and wage schedules, holding examinations, certifying eligibles, devising and assisting in the administration of service ratings, promoting good working conditions and effective training programs, and advising in the operation of retirement systems. Under this arrangement, the public works administrator has the opportunity to consult with the personnel agency on the personnel techniques and has sole responsibility for determining departmental positions, appointing needed personnel from eligible lists, inducting employees into their positions and training them in specific assignments, and for supervising and coordinating their work. In the absence of an adequate or qualified civil service or personnel staff, in many cities and jurisdictions a system has resulted that recruits inferior employees and makes it difficult for the public works officials to dismiss them, once they are in the department. Civil service has often served to hinder departmental administration by certification of unqualified persons, impractical rules, improper classification and salary plans, rigid restrictions on employee assignments and adjustments, and unwarranted reinstatement of discharged employees. The notable change in emphasis has been to

make personnel management a constructive part of the administrative process.

Personnel Service for Small Communities

Administrative and technical skill in personnel work has been made available to small communities through at least two different arrangements. In California, Michigan, Arkansas, and New Jersey civil service enabling acts authorize large agencies to furnish personnel services on a contract basis. In the first mentioned, the service may be rendered by any municipality or county within the state while the Michigan, Arkansas, and New Jersey state personnel agencies are authorized to perform the function. During the last year the Michigan Municipal League, assisted by the Civil Service Assembly and Public Administration Service of Chicago, has continued its program of service to Michigan cities, including: first, preparation of legislation, rules, and regulations which outline the scope and define the objectives of the personnel program; second, installation of the specific machinery in several municipalities whereby these objectives were to be obtained; third, assistance on day-to-day operation once the program was defined and the machinery established.

Public Works Training

An example of what can be done along the line of in-service training of public works employees is the inauguration last fall of a training program in the department of public works in Detroit. This course is open to employees of all divisions of the public works department. Instruction is given not only in many phases of public works problems, but also in general municipal governmental problems. The classes, attended by eighty to one hundred employees, have covered such topics as the general organization of the city government, the relationship of the public works department to other departments of the city, the background of the ordinances and the statutes which affect the public works department, construction of roads, streets, sewers and street cleaning, refuse collection and disposal, water, and other public works activities.

The apprenticeship program for the staff of the board of transportation of the City of New York is also worthy of note. The program called for employment of ten recent graduates of the engineering departments of Columbia University, City College,

New York University, and Cornell University as cadet engineers. At the end of a sixteen-month apprenticeship, the cadet engineer will participate in an open competitive examination on the same terms as all other applicants. If the plan proves successful, it is intended to extend it to other engineering sections of other city departments and also to non-engineering employees of the board of transportation. New York City has also demonstrated the effectiveness of instruction in the creation of its snow removal training school at Lake Placid, New York, where in groups of thirty the employees of the snow fighting force of the department of sanitation are given three-day instructional periods in the use of mechanical snow removing equipment operated by the city.

The possibilities of using state leagues of municipalities has not been extended or explored to its fullest extent in advancing training programs. Engineering colleges should also be induced to contribute and to feel a greater responsibility toward training for the public works field.

Registration Laws

Enactment of engineering registration laws has had a desirable effect in the extension of the merit principle. The establishment of minimum qualifications of positions is essential in the development of the merit system. In establishing classification plans in a number of jurisdictions, it has been found that administrative officials are sold on the use of standards established by professional societies for the various degrees of membership as well as on the use of standards established by registration laws. The recognition of higher standards is a definite need in the establishment of a career service in government.

Planning and Programming

Harold Merrill and Charles Wiltse
National Resources Committee

Public construction has been one of the functions of government since the Romans first built roads and aqueducts, and for almost as long the planning and financing of improvements on a large scale has been a major governmental problem. Since the authorization of

the first land grant in 1787 the federal government has built or subsidized the building of roads, canals, and waterways, of lighthouses and harbors, of public buildings, railroads, and irrigation and drainage works, of power dams and bridges. In the same period, state and local expenditures for public works exceeded federal outlays manyfold until the total volume of construction by all units reached a maximum of more than three and a quarter billion dollars for the year 1930.

This huge capital outlay for public improvements has resulted in better living conditions and in better prospects for future generations; but it has also had a far-reaching influence on our economic life. The federal government took notice of the impact of public construction on the national economy as early as 1919, when Senator Kenyon proposed the creation of an Emergency Public Works Board, but the matter did not come to a head until 1931 when economic depression had made it again a question of vital concern. In that year the Employment Stabilization Act was passed, declaring it to be the policy of Congress "to arrange the construction of public works so far as practicable in such manner as will assist in the stabilization of industry and employment through the proper timing of such construction." Heads of federal departments and independent establishments having jurisdiction over construction agencies were directed "to prepare a six-year advance plan with estimates showing projects allotted to each year"; and the Federal Employment Stabilization Board created by the Act was asked to collect "information concerning advance construction plans and estimates by states, municipalities, and other public and private agencies which may indicate the probable volume of construction within the United States or which may aid the construction agencies in formulating their advance plans."

The policy of using public works on a large scale as a device for economic stabilization was given its first though inadequate application in July 1932, when Congress appropriated $300,000,000 for this purpose, and authorized loans from the Reconstruction Finance Corporation for self-liquidating state and local works to an aggregate of a billion and a half; and with the passage of the National Industrial Recovery Act in May 1933, with its $3,300,000,000 appropriation, a new era in public construction got under way. In this connection, it may be noted that when this program was launched the Stabilization Board was able within a few days to present an

expanded program of work for several times the federal share of the appropriation and had held personal conferences with the bureau chiefs concerned. This test would not have been possible had it not been for the programs and data in its possession and experience gained during its two years of existence. The Stabilization Board's program was used as a basis for the selection of federal projects for the allotment of funds by the Public Works Administration.

Progress in Programming

The work begun by the Stabilization Board for encouraging public works programming by state and local governments has been carried forward during the last three years by the National Resources Committee, cooperating closely with other federal agencies, and working through the state planning boards with state and local governments. The magnitude and importance of the problem is indicated by estimates that thirty billions of dollars will probably be spent in the normal course of events during the next ten years on the usual volume of public construction by federal, state and local governments.

Federal Developments. Long-range planning and programming of public works by the various construction agencies of the federal government has already made notable progress. The first six-year program of construction projects was prepared by the Stabilization Board in 1932, and in accordance with the Act has been annually revised and extended one year. By Executive Order on March 1, 1934 the Employment Stabilization Board was abolished and its functions transferred to the Federal Employment Stabilization Office created in the Department of Commerce by the same order. Due to lack of appropriations to continue the work of the latter, the revisions of 1936 and 1937 have been made under the auspices of the National Resources Committee by the Projects Division of the Federal Emergency Administration of Public Works.

In cooperation with federal, state and local agencies, the National Resources Committee also assumed responsibility for preparing in 1936 a comprehensive long-term program for the development and control of the water resources of the major drainage basins of the country. This program was an attempt to fit water projects, both federal and non-federal in nature, into a general plan for each drainage basin as a whole, and to determine the approximate order in which these projects should be constructed. A nation-wide revision

of the program was made in 1937, through the organization of forty-five basin committees, set up to consider the water problems of their respective areas. These committees were representative of federal, state and local agencies interested in the development and conservation of water resources, and were served in an advisory capacity by regional water consultants appointed by the National Resources Committee. A technical water committee in Washington reviewed the revised programs of the various basin committees with special reference to national and interregional requirements.

State Developments. Among state and local governments, however, the practice of long-range planning and programming of public works is, with a few notable exceptions, of recent origin and uncertain future. To stimulate this work on the part of non-federal agencies, the National Resources Board cooperated with the state planning boards and the Public Works Administration in conducting a National Inventory of Works Projects early in 1935. The survey was carried out by the state planning boards, collaborating with P.W.A. state engineers, with staff assistance supplied by the Federal Emergency Relief Administration. A second inventory was undertaken in July 1936, with the responsibility for participating in it left solely to the individual state planning boards. Wholly aside from the uses made by Federal Emergency construction agencies of the project lists compiled, the inventories served to emphasize the need for non-federal long-term planning.

Tabulation of the state and local projects reported in the second inventory was completed in July 1937. Some 75,000 projects from thirty-six states were included in the tabulations, and the total estimated cost over a six-year period runs to about seven and a half billion dollars. Adjusting the figure to include states not reporting and to correct those whose reports were incomplete, the estimate of cost would probably be in the neighborhood of fifteen billion dollars. This is an annual average about equal to the average yearly outlay for public works by non-federal agencies in the decade prior to 1930.

The material included in this inventory is, of course, in no sense a comprehensive program of non-federal public construction for the next six years. It represents rather a first effort at introducing the long-range programming of public works as a normal function of all governmental units having jurisdiction over construction activities. It does, however, supply some of the basic data out of which

long-term programs of state and local public works may be evolved, and it offers also some basis for developing an improved procedure for formulating future programs.

Just as the planning boards have contributed to the success of public works programming through the inventory procedure, the process of taking the inventories has better prepared the boards for rendering greater assistance in the future planning of public works. In many cases the projects reported are stated in most general terms, and before they can be adequately evaluated, more information must be secured as to the long-range plans which may lie behind immediate proposals. The inventories have served to guide the boards in seeking needed background material, and have justified them in requesting further information from reporting authorities in order to make the best use of the material already secured. In brief, the inventories have served to assist state planning boards in their coordinating functions among state and local authorities, particularly in bringing out long-range programs not previously available from cooperating agencies.

Through their contacts with state and local governments and with county, municipal, and regional planning agencies on the one hand, and with federal public construction agencies and the national planning agency on the other, the state planning boards promise to become an important factor in the efficient operation of the federal system. The planning boards are in a position to act as public works councils, stimulating interest in public works programming on the part of state agencies and local governments, supplying technical advice, and from the larger point of view of the state as a whole integrating the various programs prepared by counties, townships, and municipalities.

The state planning boards are in fact the legally constituted public works programming agencies in twenty of the thirty-nine states having statutory boards; and in another fifteen of these states the boards have been given advisory powers with reference to planning the coordinated development of natural resources. The most thorough-going powers in the public works field have been conferred on the state planning boards of Pennsylvania and Indiana.

Local Developments. Public works programming has hitherto lagged in local communities, partly because of the sporadic nature of local construction activities, partly because local officials usually serve on only a part-time basis, and partly because the relation of

local construction to the more extensive programs of state and federal governments was not clearly understood. The emergency public works activities of the federal government, however, and the educational work of planning agencies have served to demonstrate the functional unity of all public construction at whatever level it may take place, and to emphasize that it is the local community that has most to gain from long-range programming of public works.

It is definitely to the advantage of town and city to know in advance what construction of county roads and state and federal highways will be undertaken in any ensuing six-year period, to know what river and harbor developments will be begun, what state and federal public buildings are contemplated for construction. And it is as surely to the advantage of the local community to plan its own construction activities to fit into a general pattern including all governmental units. Similarly, only by making its own intentions as to schools and streets and public utilities known can these be fully integrated with the plans of other and overlapping jurisdictions.

Outstanding among recent achievements in public works planning and programming below the state level are the planning provisions of New York City's new charter. The City Planning Commission under the charter promises to become an effective instrument of government, with responsibility for the preparation and adoption of a Master Plan for the city, custody of the official city map, the right to initiate changes in either map or plan, and the power to hold hearings on any changes proposed by others. Public improvements called for in the Master Plan are to be programmed by the Commission and submitted in the form of a capital budget to the Board of Estimate. While projects may be eliminated, no projects may be added by the Board of Estimate except by a three-fourths vote.

Importance of Comprehensive Planning and Programming

Comprehensive planning, which fits a series of individual projects designed for construction over a period of years into an organic whole, makes possible the attainment of larger goals than can be realized by piecemeal and unrelated effort. Examples of the ends which may be achieved by relating construction projects to a long-range plan are the development of the waterfront of Lake Michigan in Chicago, the Columbia River projects in the Pacific Northwest, and the proposed parkway around Manhattan Island. These develop-

ments are too vast and too costly to be accomplished at any one time, but become feasible and financially practicable if the work is spread out over a long period. Then, too, the value of the constituent projects in a large-scale planned development may be increased by coordinating them into the more comprehensive scheme, such as that for the improvement of the Tennessee Valley.

In urban areas the coordinated construction of transportation systems, parks, and public buildings is possible only on the basis of long-term planning, as is the designation of particular areas for industrial, commercial, or residential uses. When community development is planned, and public construction is coordinated with the plan, waste of both private and public funds on improvements unsuited to the ultimate character of the locality may be avoided. The coordination of street construction with the extension of sewers, water and light systems, and street railways has advantages too obvious to mention.

On a more extensive scale, still greater ultimate savings are possible by the long-term programming of public works in conjunction with plans for land and water utilization. Such elements as reclamation and reforestation, flood control and irrigation, highway construction and the withdrawal of submarginal lands, are intimately related, and should be considered together as parts of a single plan for the development of an area or region.

The comprehensive plan is the first step in the efficient and orderly development of public improvements. On the basis of the plan, projects called for within the next six-year period should be programmed by years in order of priority; and a long-range capital budget should be made up for carrying the program into effect.

Broadly considered, public works programming is the process of determining what public improvements incorporated in the comprehensive plan will best serve social ends and carry out governmental policy for the period under consideration, and of establishing the appropriate priority relationships. Programming will be concerned, therefore, with determining the desirable volume of public works for the current year or biennium, and for a more extended period, and with the distribution of the total volume, geographically, by type of work and among political jurisdictions.

Consideration of these questions involves examination of the functions served by public works, and possible alternative means of serving the same functions. Public works are necessary means of

supplying certain essential services, but the planning agency should seek to determine what services are necessary in any given period in the light of private construction, industrial development, and other relevant factors. Public construction may also be an instrument for carrying out governmental policy aside from the direct services offered. Relief of unemployment, demonstration of new methods, equalization, economic stabilization, and national defense are among other possible purposes of public works.

It is the responsibility of the planner to propose those types of construction most likely to achieve the desired result. For example, if equalization is the purpose, then federal rather than non-federal construction is indicated. If unemployment relief is the purpose, then projects involving a high percentage of labor cost will be wanted; or perhaps works requiring the skills of particular trades if the unemployment is concentrated or centered in particular industries. For purposes of economic stabilization a flexible program will be desired, which can be expanded as forecasts show declines in general business activity.

Public works programming also requires a consideration of alternative methods of achieving the same purpose. Relief of unemployment, for example, might also be accomplished by direct dole, tariff reduction to break down trade barriers, industrial loans or unemployment insurance, as well as by extensive public construction. Economic stabilization might be achieved as well by credit expansion or currency manipulation as by public works; while a desired level of public service facilities might also be achieved by offering inducements to private enterprise.

Then, too, government may pursue through public works a policy incompatible with its efforts in other fields, and this also might be considered in planning. For example, if the government is pursuing a policy of crop reduction, reclamation projects might be questionable. If loans for rehabilitation purposes were being offered to the railroads this factor would have to be considered in programming highway and waterway projects which might offer destructive competition.

Priorities and Criteria

After the desired volume, types, and distribution of public works have been determined, taking all available data into account, a program of specific projects spread over a period of years may be

formulated. The program should fix priorities for at least two years ahead, and in addition should include such projects as are believed to be needed during the six years or even longer period, which may be reviewed and priorities assigned from year to year as the program is annually revised and extended.

This type of program is suggested as a minimum. Priorities for each of the six years of the program should be at least tentatively fixed if data for doing so are available, and for some large-scale developments a ten-year period is not too long. Another alternative is to prepare a general reservoir of projects extensive enough to take up the probable construction funds available over a six- to ten-year period, but with only the relative time sequence indicated for projects. This method, however, cannot be used satisfactorily with an actual long-range capital budget. If funds are to be apportioned in advance for any considerable period, priorities within the period must be fixed, subject always to annual revision.

The selection of projects to be included in the program and the time sequence of these projects within the period covered will depend in large measure on two major factors. These are *permanent social need and financial advisability*. If the purpose of the program includes stabilization, *employment potentialities* may be added as a third criterion. These standards are, of course, relative only and are offered with no thought of determining the absolute worth of a project but only as a guide to judging the relative importance of the various projects offered for inclusion in the program.[1]

Summary

Public works may serve many purposes, such as supplying necessary facilities, economic stabilization, or the conservation of natural resources; but all of these purposes may be more effectively and more economically achieved if construction projects are conceived well in advance of need as integral parts of a sound comprehensive plan, fitted into a long-range program, and provided for in a long-term capital budget. Public construction which has been anticipated to the extent of making it a part of a long-term program can more

[1] These criteria are discussed in detail in the National Resources Committee's *Suggested Procedure for Public Works Programming* (Preliminary edition, July 1935). See also Russell V. Black, *Criteria and Planning for Public Works*, National Resources Board, 1934.

easily be financed from current revenues, and when bond issues are required, it will be known long enough in advance to secure the most favorable terms. The long-term program also supplies a workable basis for negotiating with other governmental units, where more than one jurisdiction is served. In short, the essentials of sound public works policy are: (1) the comprehensive plan; (2) the long-term construction program; and (3) the long-term capital budget.

If we are to avoid waste and duplication and promote orderly and unified development, there must be not only careful planning of public construction by each governmental unit, but also coordination of local programs with state, regional and national programs. The strength of democracy lies in its flexibility, in its receptiveness to experiment, and in its readiness to devise new techniques for coping with changing economic and social conditions. Coordinated planning through federal, state, and local agencies is such a technique; and its success in the field of public works programming has elevated it from the realm of experiment to the category of a definitely workable procedure, even though it is still far from perfection.

Budgeting and Accounting

GUSTAVE A. MOE

Public Administration Service

PUBLIC works activities have become so extensive in scope and so complex in nature that public works administrators are quite unable personally to supervise all of the work for which they are responsible. They must, therefore, rely upon prompt information provided by reports of others. Important as it is to have a sound organization plan and competent personnel, however, blind reliance upon subordinates is not sufficient. Casual observations are informative to the trained administrator but at best they give only an incomplete picture of conditions and performances; they pro-

vide no analysis of costs; and they force reliance on memory alone for facts concerning past operations.

Efficient public works management requires measurements of output and the relation of that output to costs and expenditures. Such knowledge enables the management to appraise performance and costs; to reward or to reprove those in general charge of the several operations; and to plan future programs of work. However, measurements of performance and costs are ineffective and valid comparison of cost figures with those from other periods or other jurisdictions are impossible without some standard unit of measurement which can be applied to each public works operation or activity whenever or wherever it occurs and which is relatively constant under all circumstances. These standards become an integral part of the whole budget plan, both in estimating future expenditures and in the control of work done. Without such units of measurements, cost accounting systems may actually produce information which will lead to erroneous conclusions and unsound decisions.

Have the developments in budgeting and accounting practice for public works activities kept pace with other improvements in public works operations? There are many indications that extensive improvements have been and are being made in financial planning and cost accounting control over public works activities. Several groups of public officials, in both the public works and municipal finance fields have been working earnestly to improve techniques, procedures and methods of accounting and budgeting control for public works activities. The progress being made covers every aspect of public works and touches all branches of our government. The federal government, through the P.W.A., the C.W.A., the F.E.R.A., the W.P.A., and the Bureau of Public Roads, has assisted in many ways in improving accounting and operating procedures by the distribution of manuals covering the subject to state and local governmental agencies.

As an illustration of what has been done by organized officials, last year, at the national conference in Boston, a committee of the American Association of State Highway Officials reported on a uniform plan of accounting for state highway maintenance. This system when available should aid in bringing about uniformity in highway budgeting and accounting. The National Committee on Municipal Accounting and the Municipal Finance Officers' Associa-

tion has published a recommended accounting terminology and have cooperated with the Bureau of the Census in revising that agency's classification of municipal expenditures. It should not be long before there will be more uniformity in public works budgets throughout this country.

Another important aspect of budgetary control and finance for public works is the realization of the administrators of the need for competent and well-trained accountants. This type of personnel is necessary if public works officials are to achieve the cooperation and coordination with other branches of government which participate in financing and carrying on these activities.

Budgeting Public Works Expenditures

It would be impossible in this short article to cover all of the problems encountered by those responsible for the design, installation, and operation of budgeting and accounting systems. Suffice to say that any of these systems must of necessity face local situations and be adapted to local needs.

The budgeting of public works expenditures involves a series of logical steps beginning with the preparation of requests for appropriations by the public works department. These requests should be supported by a statement of the volume of work to be done for the funds requested. This step is often referred to as a "Work Program." The next step requires the coordination of the public works requests with those of the other units of government into a master budget. When the appropriations are posted, the public works official is then faced with its execution.

Experience indicates that it is not a difficult task to prepare a public works budget which can be supported by a work program. The steps required are: (1) forecasting the amount of work to be done in each category of public works activities, in general when it is to be done and the methods to be employed; (2) establishing an estimated total cost, and also a unit cost or "unit cost standard" for each activity; (3) consolidating the detailed forecasts of work and costs into a comprehensive work program which will show for each activity by months the amount of work to be done, the unit costs standards, and the total costs. The execution of the work program during the year requires the use of cost accounting machinery to tell whether actual work and costs compare favorably or unfavorably with the work program estimates and standards.

Those expenditures for operation and maintenance of buildings, streets, roads, bridges, sewer systems, water systems, and allied facilities are important and represent a large portion of the annual city, county, or state budget. It is just as necessary to support these types of expenditures with well-defined programs as it is to prepare quantity analyses and cost estimates for capital improvements. Otherwise, the legislative body cannot rationally determine the advisability of spending public funds for public works activities.

Preparation of a budget which covers only a single year without reference to the requirements of future years is no longer regarded as adequate budgeting, particularly in the public works field where it is necessary to finance improvements requiring more than one year to construct. During the past few years, there has been a growing tendency throughout the country to prepare long-term financial budgets. These budgets are planned so that the physical improvement programs and financial requirements are projected into the future and forecast over a period of years. They do not, of course, include the annual appropriation for future years.

A five-year budget is a master plan which is subject to revision from time to time in the light of changing circumstances and into which the annual budget for current operating and maintenance expenses are fitted. It is true that to date most of the attempts in this direction have been confined to capital improvement programs with only incidental consideration of other factors such as the operation and maintenance, fixed charges, and changing service requirements.

The preparation of an effective long-term budget for a city, as an example, involves the following: (1) a study of the needs of the city, in the light of the services which have been rendered in the past; (2) a study of the probable future trend in public policy in this regard; (3) a forecast of the expenditures involved in the foregoing, (4) an analysis of the trends in assessed valuation, tax delinquency, public debt, and all other trends in the community having a bearing on the future tax-paying liabilities; (5) a forecast of the city's revenues and expenditures.

Long-term budgets have very definite advantages. They may enable a city, county, or state to bring about a gradual and orderly development of a public improvement program to avoid costly errors, to establish a bettered financial position, and to eliminate interest charges through adoption to the fullest extent possible of the

pay-as-you-go principle. Such orderly management will place public works activities in the most favorable light in the eyes of both taxpayers and investors in municipal bonds.

Accounting for Public Works Expenditures

One of the most important requirements in accounting for public works expenditures is the establishment of the proper control accounts in the official records of the local governmental agency. This involves cooperation and consultation with the chief finance officer involved. In some cities, the general accounting system recognizes allotments of expenditures and when these are used it is necessary for the public works officials to be well acquainted with the accounting processes and work closely with the chief finance officer.

The main purpose of a public works cost system is to provide administrative officials with a workable control mechanism. The cost accounting system should provide a regular method for compiling and analyzing the work done and its costs. The information provided aids administrators to organize their work and to prepare a sound budget and to determine whether the amount of work performed conforms with the amount planned. They can also determine with certainty which methods or equipment are most effective or the cheapest. With these facilities at hand, activities can be conducted on a more systematic basis, thereby producing more and better work for the money spent.

A distinction must be made between accounting for expenditures and cost accounting. Under a system of cost accounting expenses are related to some other measurable quantity of work done. Expenditure accounting, on the other hand, is interested only in accounting for income and expenditures and in analyzing types of purchases; it is not at all concerned with the work accomplished by such purchases. Some of the purchases may consist of materials or equipment which may be used during later months or years. Under a cost system only that portion of the purchases is considered which is consumed in performing a definite amount of work in a definite period of time.

In the past, many cities have ignored this distinction in calculating unit costs by dividing the expenditures over a period of time by the work units during the same period. In no case can such a method furnish accurate costs of work done. Not only does this practice

produce misleading figures, but the cities employing it do not benefit from the control exercised by proper labor, material and equipment records and reports.

From the various forms used in cost accounting procedures, it is possible to obtain comparative data on expenditures, work done, unit costs, man-hour production, and other significant items. It is also possible to utilize for administrative purposes the weekly and even the daily reports of labor, materials, and equipment consumed. Although it is important for public works administrators to obtain cost statements, it is also important that they receive from their fiscal officer a monthly statement of expenditures which will show the obligations outstanding to indicate the free balance for further expenditure. Most financial officers are equipped with mechanical equipment so that they can furnish this type of statement in time to be of value for administrative action. Whenever this can not be done by the finance officer, there is only one alternative and that is for the public works official to maintain the necessary records to provide the statement in his own department.

Administrative reports from the cost accounting system take another form since they can provide comparisons either with previous unit costs or against pre-determined unit cost standards. These statements may be expanded to cover comparisons of production per man-hour and per equipment-hour which indicate the performance features of each project or particular item of work.

Budgeting and Financing of Plant and Equipment

One of the important problems in public works financing and budgeting pertains to the operation of plants producing construction materials such as asphalt, gravel, and mixed concrete, or such articles as street signs, small tools, and other minor equipment; another accounting problem is involved in the scheduling and maintaining of motor equipment.

When a central equipment bureau has charge of all motor equipment, the operating divisions are charged for the equipment service at actual cost on the basis of a rental rate per hour or per mile. These rental rates are determined by the central equipment bureau from its cost records of individual pieces of equipment, and include depreciation as well as operation maintenance and overhead expense.

A method of financing such a central equipment bureau which

has proved successful is to establish a small revolving or rotating fund. This fund acts as working capital from which the salaries of employees in the repair shop, the cost of gasoline, oil and repair parts, and the overhead for the garage or equipment center are paid in the first instance. As the equipment is used, this rotating fund is reimbursed by charging each of the several divisions of the public works department for the use of equipment through the rental rates mentioned above. Over a period of time the rental rates equal the actual cost of maintaining and operating the equipment so that the revolving fund is reimbursed fully for the total amount of its expense. This means that the revolving fund at all times has a cash balance and with the accounts receivable added to this balance, it can be reconciled as to its total original amount.

By this procedure each operating unit in the city or each division of the public works department bases its appropriation request for equipment use upon the number of hours or miles each type of equipment will be needed as determined by an anticipated work program. Thus, instead of appropriating funds for the purchase of gasoline, oil, repair parts, and so on, a lump sum appropriation is made for rental of equipment. By including depreciation in the rental rate, a replacement reserve is built up as a separate account of the equipment revolving fund, so that as each piece of equipment wears out there is sufficient money available to make an immediate replacement. In this way the purchase of equipment will not create large variations in the budget from year to year as happens so frequently in cities at the present time. Additions to equipment, distinct from replacements, are financed separately by a direct appropriation to the equipment bureau.

A revolving fund is also of advantage in financing the operation of asphalt plants or other enterprises which produce commodities for use in the field. Appropriations for the materials turned out by such plants and used by operating bureaus are estimated exactly as though they were to be purchased from outside parties, in accordance with the selling price determined by the plant operation. Bills are prepared at the close of each month whereby the proper accounts are charged and the revolving fund credited with the corresponding amount. If the estimates are properly based and plant costs calculated in proper fashion, this amount should replenish the revolving fund to its fullest extent at any particular time.

Other plans of financing, accounting, and budgeting for plant

and equipment are in operation in Cincinnati, Ohio; Flint, Michigan; Newark, New Jersey; Binghamton and Troy, New York; Kenosha, Wisconsin; Minneapolis, Minnesota; and a host of other cities. It is not within the scope of this article to give an exhaustive list.

In the new era that lies ahead for public works administration, there is much to be done to improve budgeting and accounting practices in order to keep pace with the changing conditions of finance and field operations. With continued rapid improvement in machinery, it is increasingly important to know the cost of using the old equipment. It is necessary also to know if it has been profitable to replace labor by new equipment. Of great importance, too, is the relationship of human labor to machines. Continued research in plans of financing, budgeting, and accounting for public works must go forward.

Public Works Organization:
Lincoln's New Form of Government

D. L. Erickson

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Nebraska is noted for being conservative both in thought and in action. As a state, it has no bonded indebtedness, has built a ten-million-dollar State Capitol, and is building a state highway system on a pay-as-you-go plan. Although conservative, it nevertheless has courage to do pioneering as witnessed by the fact that last year it installed a unicameral legislature.

Similarly, Lincoln, the capital city, is conservative and yet willing to pioneer. Since 1913 Lincoln had been under the commission form of government but in May 1937 it started to operate under a new form of city government which is unique in many respects.

This new form was called the seven-man council plan. The council consists of the Mayor and six councilmen all elected at large. The Mayor has a term of two years and the councilmen a term of four years, with provision for overlapping so that every two years

there will be elected a Mayor and three councilmen. The salary of the councilmen is $10 for each regular weekly council meeting attended, and the Mayor receives an additional sum of $500 per year. All executive, legislative, and judicial powers and duties are lodged in the council.

Under the commission form of government, Lincoln had lately been having difficulty in getting the right kind of men interested in serving on the council. This apparently was remedied by the new seven-man council plan, as a group of very high type men offered themselves and were elected to the new council. The new Mayor is a leading coal dealer and is the only member on the present council who was on the previous one. The remainder of the new council is composed of two managers of large mercantile establishments, two prominent lawyers, a successful independent grocer, and an officer of a large real estate and investment firm.

Division of Functions

The affairs of the city are administered under the direction and supervision of the council by three Directors in charge of the following departments: Department of Public Welfare and Safety; Department of Accounts and Finance; and the Department of Parks, Public Property and Improvements. The Directors are appointed by the city council and are required to devote their entire time to the duties of their office. Any Director may be appointed to serve the city in any office in addition to that of Director. The City Attorney is appointed by the council and serves all departments directly under the supervision of the council.

As Director of the Department of Public Welfare and Safety, the council appointed the man who had been commissioner of streets on the last council, and who also had served several years as Mayor of one of the recently annexed suburbs of the city. As Director of the Department of Accounts and Finance, there was appointed the man who had been City Clerk and Auditor for the past twenty-four years, and this Director continues to serve as City Clerk. As Director of the Department of Parks, Public Property and Improvements, the council appointed the man who had been City Engineer for the past fourteen years. In addition to being Director of this Department, he continues to serve as City Engineer.

By ordinance, the various activities of the City were divided among the three departments as follows:

1. The Department of Public Welfare and Safety: Fire, Police, Health, Custody of City Buildings, and Municipal Gas and Coal Station.

2. The Department of Accounts and Finance: City Treasurer's Office, City Clerk and Auditor's Office, Purchasing Agent, and Tax Commissioner.

3. The Department of Parks, Public Property and Improvements: Water and Light, Parks, Streets, Sewers, Paving, Sidewalks, City Engineer's Office, Airport, Building Inspection, Plumbing Inspection, and Recreation.

The above division of activities among the three departments is a very logical one in Lincoln, and offers a great opportunity for efficient management. Already many changes and improvements have been made.

Forward Steps

In the Department of Parks, Public Property and Improvements, a regrouping of certain activities has been made so as to better correlate the Park and Street Divisions. A separate Recreation Division has been set up under a trained recreation administrator, in which have been placed all of the recreation activities of the City. Part of these were formerly handled by the Park Department and part by the School Board. A complete cost accounting system has been installed through which the costs of the various functional operations in this Department are determined, including unit costs on all types of equipment. A study is now being made of the municipal electric rates and long-range plans are being prepared for the Water and Light Plant.

In the Department of Accounts and Finance a central purchasing office has been installed through which all purchases by all City Departments are now being made. A new modern accounting system has been installed and plans are being made for a new system of tax billing and records.

All of the members of the new Council have shown a strong interest in each of the Departments and Divisions, which has been furthered by the fact that the Council does not have any standing committees but acts as a Committee of the Whole on all matters. All three Directors attend all Council Meetings so that the Council gets first-hand information on any Department or Division at any

meeting. In addition, the Directors hold weekly meetings, and meet more often when necessary.

Recently the Council appointed a Personnel Officer and studies are now being made preparatory to the adoption of a modern merit system for all city employees. As soon as this is completed the Council intends to study the question of a pension system for all city employees.

It will be noted that this so-called seven-man council form of government in Lincoln is really a modified manager form with three Directors or managers reporting direct to the City Council. It is believed that this new Lincoln form has all of the advantages of the manager form and does not have some of its occasional disadvantages.

With less than a year's trial, it is naturally too soon to predict the final success of this new form of government, but if the present spirit of cooperation continues between the Council, Directors, and employees the present rate of progress should continue and this new form is then bound to succeed.

Public Works Organization:

Boston's Attempt at Reorganization

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Boston Municipal Research Bureau

In 1936 an unsuccessful effort was made to consolidate public works services in Boston. Although drawn by experts, the reorganization plan provoked a controversy which illustrates the difficulties of comprehensive change.

Boston's government consists of 47 separate departments under 140 department heads and board members, many removed from mayoral control. This tangled skein of agencies, criticized by Mayor Matthews forty years ago, required a depression emergency to bring even the promise of relief. When Mayor Frederick W. Mansfield assumed office in January 1934, his retrenchment program carried a pledge of departmental reorganization.

Preliminary Steps. As a step forward, Mayor Mansfield secured a charter amendment from the legislature widening authority to

make structural changes by ordinance. When this enabling law was considered, there were rumblings of the opposition which any rigorous consolidation scheme was certain to arouse.

Nevertheless, the Mayor went ahead by requesting President Karl T. Compton of Massachusetts Institute of Technology to appoint a committee to consider unified public works administration. Thereupon President Compton named Col. Robert C. Eddy as Chairman to act with Charles B. Breed and Charles N. Norton, all of the M.I.T. faculty. On May 16, 1935, the committee suggested a consolidation scheme, which was turned over to the Law Department for study of the legal angles. In December 1935, the Mayor sent both the consolidation plan and a draft ordinance to the city council with a strong recommendation for adoption.

Existing Public Works Set-Up. It is first necessary to view the scattered type of organization which the committee was asked to correct. The existing public works department has large operating divisions for streets, street lighting, traffic tunnel, bridges, ferries, sewerage, water, and waste removal and disposal. The street laying-out department assumes jurisdiction of various public works locations. The transit department constructs and has custody of city-owned rapid transit facilities leased to the Boston Elevated Railway Company.

Moreover, the park, public buildings, building, weights and measures, and market departments have additional public works functions. And the wire division of the fire department has regulatory and inspectional duties of a public works character.

Consolidation Planned. Col. Eddy's group proposed to consolidate nine of these ten departments and agencies, which employed 3,800 persons and spent about $17,400,000 in 1936. The committee would have included the traffic commission as well, since it installed and maintained traffic control devices, but the law department omitted this agency from the draft ordinance.

The object of the committee's report was to unify public works agencies as a move toward a limited number of major city departments, which experience elsewhere indicated was the best set-up. Only those agencies which were felt to have a definite functional relationship were included in the public works plan. The consolidated public works department, organized on the "line and staff" principle, was to be under a commissioner answerable to the Mayor. The commissioner and the two deputies under him formed

a board vested with present statutory powers of the street commissioners.

One deputy commissioner headed the five staff divisions: survey and project, design and construction, building inspection, standards, and electrical. Engineering services were to be available both to the public works department and to other city departments as required. Thus the testing laboratory in the standards division was to serve the whole city government. Regulatory powers residing in three separate departments were placed in the inspection, standards, and electrical divisions.

The other deputy was in charge of the seven line divisions: bridge, tunnel, ferry, and airport; highway; sanitary; sewer; water; park; and public buildings. While the first five of these maintenance and operating divisions were carry-overs from the existing public works department, the other two were added functions.

An executive secretary of the department was to have exercised financial, personnel, and legal duties and was to be responsible for water billing and issuance of permits.

Wide latitude was left for internal organization of the several divisions. Savings to be expected were not stated in terms of dollars and cents, nor was mention made of how many employees would be required or where they would be assigned. The committee rested its case on better planning and coordination of public works, enhanced budget control, and elimination of conflicting efforts. Their scheme was the first broad-gauged alternative in twenty-five years to an intricate, overlapping system.

Nature of Opposition. Consideration of the plan by the city council dragged out for a year. Five times submitted by the Mayor, the consolidation was rejected on each occasion. Of twenty-two members, only three stood firm for adoption.

Objections raised to the plan were a mixture of real and specious reasons. Councilors asserted not only that the consolidation was an impractical design of theorists with little knowledge of the city's public works, but also that it included activities not of a public works character. Any tendency to describe advantages in general terms, or to claim savings without saying exactly what economies would result, was ridiculed. Aside from the councilors themselves, there was no vocal opposition. The Boston Finance Commission in an unfriendly report complained that the consolidation embraced some unrelated functions. However, the attitude of this body, which

consistently was hostile to the Mansfield administration, did not carry conviction in all quarters.

Wide public support was lacking. The Municipal Research Bureau sided with the plan, and certain elements among the press, radio, and citizens' groups were spurred to action. While this support put some councilors on the defensive, most remained shrewdly silent, and the final outcome was not changed.

Real Reasons for Defeat. Failure of the plan was probably due in large measure to employee opposition. One out of five on city payrolls was indirectly threatened, and ward representation in Boston makes council members particularly sensitive to employee desires. Repeated assurances by the Mayor and friends of the plan, and safeguards for employees in the draft ordinance, were evidently regarded as inadequate.

Furthermore, the plan radically altered departments slated for merger. The wire division of the fire department resented loss of identity. Likewise, the status of the park department, some of whose functions related only incidentally to public works, was endangered. Settled routines would have been disturbed, and those involved felt they had nothing to gain and everything to lose from such an upset. Finally, doubt exists as to how far the plan had active mayoral support after the extent of the opposition became known.

The city council on December 15, 1936, rejected the proposed reorganization for the fifth time. However, it set up a special committee to study "possible steps for the consolidation" of city departments. So far this committee has not reported, but presumably it has been studying the question.

Here matters stand. It is possible that deepened financial stringency and a new administration may yet bring public works consolidation in modified form.

FINANCING PUBLIC WORKS

Federal-State-City Relationships

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When the effects of the economic disturbances following 1929 had created a situation in which existing agencies were unable longer to cope with the problems of widespread unemployment, and when such responsibility as was assumed by government was still being placed wholly on local agencies, local "made-work" programs were set up in many communities. In 1931 the passage of the Federal Employment Stabilization Act provided for "the advance planning and regulated construction of public works, for the stabilization of industry, and for aiding in the prevention of unemployment during periods of business depression." Although at the time of this legislation the need for cooperation between federal, state and local governments in any aided or controlled program of public works was discussed, it was not contemplated that any direct provision would be made for acceleration of other than federal public works.

In 1932, however, federal loans through the Reconstruction Finance Corporation to states, counties, and municipalities were made available for self-liquidating public works, and in 1933 states and local governments began making use of funds provided through the first federal relief appropriations to supplement funds secured from local taxes and bond issues to carry on emergency works programs, the principal objective of which was unemployment relief.

Many federal financial relationships with local and state governments were initiated or extended as a result of the acceptance by the federal government of responsibility not only for relief of unemployment, but for the development of policies calculated to provide for the general welfare on all fronts.

In considering the ways in which federal financial relationships have affected state and local public works, the fact should be recog-

nized that in most cases the emphasis has not been upon the construction of public works with the view of creating the services and values such works provide, but upon the creation of employment. It is not the present purpose to consider federal financial aid for social services, except to the extent that use of these funds have affected public works.

Under the Civil Works Administration such employment as was afforded for public works was used as a device for spending—as a means of paying wages—in order to afford immediate and direct relief from distress and to put into circulation the sums so used for other economic relief expected to ensue.

The sums expended under the Federal Emergency Relief Administration for grants-in-aid to states, no matter how spent, were primarily spent as relief funds. The coupling of public works with the expenditure of relief funds, and the use of public works as the channel through which relief was delivered, was a development of expediency, but a natural one.

Public Works and Employment Stabilization

The idea that public works may be made a factor for stabilization of employment in times of economic emergencies is not new. The theory was advanced that public works construction should be withheld or kept at a minimum level in normal times and released or expanded during depressed periods. The extent to which this theory was relied upon by some to bring about the re-establishment of normal employment would indicate that the volume of normal private and utility construction and the employment provided thereby was not taken into consideration, if it was anticipated that public works programs could take up this slack, to say nothing of the lag in agriculture and industry. According to information gathered by statisticians of the federal government, the volume of all construction in the United States was $10,159,000,000 in 1925, increasing successively by years to a peak in 1928 of $11,060,000,000, and even in 1929 reaching a figure of $10,166,000,000. State and local public works during this period represented about 20 per cent of the total, while federal construction represented less than 2½ per cent at its highest level. In 1930 private building showed sharp decline, and in 1931 private and utility building totals had declined from the 1928 figure of $8,576,000,000 to $3,422,000,000. Further successive slumps in 1932 and 1933 are evidenced by totals for these

years in this classification of $1,411,000,000 and $1,175,000,000, respectively.

Even though it was obvious that a public works program of the magnitude necessary to offset this loss in volume was impossible, the widespread acceptance of the idea that a large volume of public construction would give sufficient impetus to employment that economic recovery would follow led to the enactment of the National Industrial Recovery Act, providing for the expenditure of three and one-third billion dollars for construction purposes through the Public Works Administration. The Public Works Administration encouraged local and state public works by grants, and became also a loaning agency to these governments. The earlier grants, for non-federal projects, of 30 per cent of costs were increased to 45 per cent for projects initiated under the programs begun in 1935 and continued in the case of the majority of projects through 1937.

Beginning in 1933 large appropriations for federal highway construction, to be expended under the direction of the Bureau of Public Roads, were made, in addition to the usual Federal Aid Highway expenditures. The Works Progress Administration, inaugurated in 1935, succeeded the Civil Works Administration and the Federal Emergency Relief Administration, and has become the principal agency for administering the program of the federal government in providing employment, whether through public construction or otherwise.

Authorization for the initiation of the program of federal work projects, known as the Works Program, was given in the first of the three Emergency Relief Appropriation Acts. The Emergency Relief Appropriation Act of 1935, approved April 8, 1935, set aside an amount not to exceed $4,880,000,000 in order "to provide relief, work relief and to increase employment by providing for useful projects." The Acts of 1936 and 1937 appropriated additional money for the purpose of continuing programs begun under the first Act. Total funds provided under the three Acts amounted to more than $8,400,000,000.

Not all of these funds were devoted to public works. Of the 1935 appropriation, more than 20 per cent was allocated to the Federal Emergency Relief Administration to permit its continuation during the time when the Works Program was being put into operation. Emergency Conservation work, including the Civilian Conservation

Corps, received 13 per cent of the total. The Bureau of Public Roads and the Public Works Administration received 11 per cent and 9 per cent respectively. Allocations in the 1935 Act to the Works Progress Administration for all its activities, amounting to $1,400,000,000, were about 31 per cent of the total. A much larger proportion of succeeding appropriations was administered by the Works Progress Administration, and for the last two years the major part of these allocations has been for construction projects.

Since May 1935, and to December 31, 1937, expenditures under these Emergency Relief Appropriation Acts of 1935, 1936, and 1937, have totaled $7,191,023,323. The extent to which this expenditure has been used for construction is shown by the following classification of expenditures, in the Treasury Report on Emergency and Relief Spending, sent by the President to Congress at the close of the calendar year 1937.

Highways, roads and bridges	$1,645,466,743.77
Public buildings	540,399,598.90
Housing projects	99,926,621.75
Public recreational facilities	553,136,024.80
Electric, water and sewage systems	410,677,347.12
Transportation facilities	202,362,919.94
Conservation work	911,478,713.37
Educational projects	642,912,767.44
Sewing, canning, gardening, etc.	535,673,774.00
Rural Resettlement and direct relief	345,925,094.72
Grants to states for relief	922,368,770.20
Administrative expenses	380,694,947.03
	$7,191,023,323.04

This report shows the total expenditures of federal funds for all recovery and relief purposes since July 1, 1932 as $13,906,669,036.69.

Appropriations for strictly federal public works, made through the various recovery and relief acts, had aggregated $3,116,780,754 at the end of 1937. The statement of the Bureau of the Budget of October 31, 1937 showed a then unexpended balance for these purposes of $289,008,735. Total grants authorized by these acts, including grants-in-aid to all agencies and for all purposes, including construction, are shown by this statement to have aggregated $9,184,541,050. The agencies through which these grants were administered, which provided funds for assistance to local or state governments for public works, included the Federal Emergency

Relief Administration, the Civil Works Administration, Public Works Administration, Works Progress Administration, Rural Electrification Administration, and the Reconstruction Finance Corporation. Additional agencies through which grants from this fund were made were Federal Land Banks, the Federal Farm Mortgage Corporation, Regional Agricultural Credit Corporation, Administration for Industrial Recovery, and the Farm Security Administration. Although some funds were made available for construction by the agencies last named, in the main their funds were for other purposes.

The Bureau of the Budget reports show a total now outstanding of nearly $4,500,000,000 in loans, made by the federal government from recovery and relief appropriations, and from the appropriation to the Reconstruction Finance Corporation. Of these, the loans made by the Public Works Administration, Rural Electrification Administration, and the Emergency Housing Loans, as well as a small part of the loans of the Reconstruction Finance Corporation, represent funds made available for public works. In addition, federal reclamation works expenditures to the extent of $172,000,000 were made on an expected self-liquidating basis.

According to the report of the Works Progress Administration, released at the end of 1937, and covering their activities through October 31, 1937, about three-quarters of the estimated total cost of all projects initiated from May 1935 through June 1937 is for construction projects. Repair, improvement, and modernization work account for a little more, and new construction work for a little less than half the total cost of construction projects. Road construction and improvement are predominant and include farm-to-market and other secondary road development, as well as important street work in many cities. Other major construction activities involve the building or improvement of schools and other public buildings, of parks, playgrounds, and recreational facilities, and of sewer and water systems. The remaining construction projects include chiefly airport work, certain conservation activities, and work contributing to sanitation and health.

Expenses borne by sponsors of projects in the W.P.A. program have aggregated $491 million, an average of 12.9 per cent of total costs. From 12.4 per cent in the six months ended December 31, 1936, sponsors' expenditures rose to 14.9 per cent of the total in the six months ended June 30, 1937, and to 21.2 per cent in the four

months ended October 31, 1937. Works Progress Administration policy has required sponsors to supply funds and services for the projects; based to some extent on Works Progress Administration opinion as to their ability to pay, and in amounts proportioned with the relative total non-labor cost of proposed projects.

The policy, to quote the Works Progress Administration report, "is designed to maximize the effectiveness of federal expenditures in providing relief employment and to effect an equitable distribution of federal funds on the basis of the amount of employment provided."

The program of the Public Works Administration resulted in allocation of funds for construction in 3068 of the nation's 3071 counties. The estimated total costs of these projects is $4,317,650,908. Loans or grants, or both, were made for 10,569 non-federal projects to cost $2,756,270,346. The cost of 15,901 federal projects was $1,561,380,562. As of November 1, 1937 the program was estimated to be more than 90 per cent completed.

Of the total costs, local and state governments supplied funds to the extent of $1,099,564,709, borrowed $797,322,483 from the federal government, and received grants in the amount of $859,383,154. The non-federal projects authorized by the 1936 Public Works Administration program, most of which were not under construction until 1937, numbered 1773, with a total estimated cost of $385,680,275, of which local and state governments supplied $210,401,629, plus $17,008,838 borrowed from the Public Works Administration, the remainder being furnished as grants by the federal government.

As of November 1, 1937, the Public Works Administration's non-federal program, authorized under the Public Works Administration Emergency Act of 1937, had made allotments for 1243 projects, having a total estimated cost of $279,350,976, for which grants of $113,373,981 were made. Local and state governments were allotted Public Works Administration loans of $57,425,700 and supplied funds totaling $108,551,295. Much of this construction is yet to begin. At the end of 1937 there still remained to be completed some $777,000,000 worth of construction for which the Public Works Administration aid in loans and grants has been allotted. There are now under construction 1368 non-federal Public Works Administration projects, exclusive of Bureau of Public Roads and power projects, upon which an estimated $500 million remains to be spent.

Non-federal projects yet to be started number 567, the construction of which involves approximately $277 million. Public Works Administration appropriations remain available until July 1939 when all construction authorized must be completed.

State and Local Public Works

According to figures compiled by the federal government, the total annual expenditures of state and local government funds for public works varied from $1,909,000,000 in 1926 to $2,335,000,000 in 1930. In 1931 this figure was $1,997,000,000. Federal Aid Highway expenditures during this period averaged less than $100 million annually, except in 1931 when this amount was $165 million. In 1932 state and local public works expenditures of local funds fell to $1,403,000,000, to which federal expenditures for road construction of $93 million may be added, with an additional amount of $14 million which was provided by the first federal loans by the Reconstruction Finance Corporation. In 1933 local funds expended for public works totaled $1,071,000,000, but federal grants and loans brought the total of such expenditures to a comparable total figure with 1932—$1,487,000,000. This $416 million is accounted for by grants of $138 million for the Civil Works Administration, $113 million emergency funds through the Bureau of Public Roads, and $73 million for Federal Aid Highways, in addition to loans of $50 million from the Public Works Administration and $42 million from the Reconstruction Finance Corporation.

In 1934, state and local funds expended fell to $850 million, but federal expenditures for state and local purposes amounting to more than $1,200,000,000 brought the total expended up nearly to the 1931 figure. Included in federal funds were Public Works Administration loans of $110 million and Reconstruction Finance Corporation loans of $61 million, in addition to expenditures of $297 million of emergency funds by the Bureau of Public Roads, $285 million by the Federal Emergency Relief Administration and $430 million by the Civil Works Administration, and $12 million in grants from the Public Works Administration and $23 million for highway aid. For 1935, local funds accounted for $1,073,000,000 of the total of $2,026,000,000 spent. Federal expenditures, including for the first time Works Progress Administration expenditures of $147 million, also included enlarged totals of $155 million in Public Works Administration loans, and $80 million in Public Works Ad-

ministration grants. In 1936 total expenditures rose to $3,258,000,000, of which $1,301,000,000 was in local funds against almost $2 billion provided by the federal government. Public Works Administration loans and grants were $373 million and Works Progress Administration expenditures were $1,223,000,000. The Bureau of the Census financial reports, covering the ninety-four largest cities, show that grants-in-aid directly received by them during 1936 from all sources and for all purposes were in excess of $372 million. The 1936 expenditure for state and local public works was divided by type of projects, as follows:

Roads, streets, bridges, etc.	$1,345,000,000
Land improvement	157,000,000
Sewers	242,000,000
Waterworks	188,000,000
Buildings and structures	950,000,000
Power construction	98,000,000
Recreational facilities	238,000,000
Other classifications	40,000,000

Complete compilation of state and local construction in 1937 for comparison with the foregoing is not yet available. During this year, construction of heavy engineering public works projects showed a slight decline from 1936, while construction carried on as Works Progress Administration undertakings increased.

For fiscal 1937, the Works Progress Administration alone expended in federal funds for construction projects the sum of $1,334,000,000. Sponsors' contributions for these projects totaled $245 million. In this program in 1937, federal expenditure of $594 million was made for highways and streets, and $169 million for buildings, $153 million for water and sewer and public utility construction, $191 million for flood control and conservation construction, and $109 million for airport, sanitation and health, and other miscellaneous construction.

Federal Public Works

Appropriations of federal funds for federal public works, all costs of which came from the federal treasury, and in the construction of which local or state governments were not called upon to participate (except for some contribution in certain cases, made for sites, rights-of-way, etc.), ranged in amount from $150 million in 1926 to $197 million in 1928. The trend in the amount spent for such federal

public works was sharply upward thereafter, each year's expenditures, with two exceptions, showing an increase over the preceding one.

In 1929 this figure reached $238 million and in 1930 $295 million. In 1931 it was $352 million and in 1932 $368 million. After 1933, when the total was $340 million, it increased to $551 million in 1934, and to $553 million in 1935. Expenditures of this type in 1936 were $525 million.

The classification of expenditures in this wholly federal program for 1936 is typical of recent years, both as to purposes and amounts, except that flood control expenditures for this year are materially higher than the average:

Reclamation projects	$ 49,000,000
Flood control, including river and harbor improvement	213,000,000
Buildings	131,000,000
Highways (traffic ways on federal property), but not including Federal Aid Highways	8,000,000
Other construction projects	124,000,000

Even though a decision was reached during 1937 to begin curtailment of heavy engineering programs, the large expenditures authorized in 1936 for such works resulted in only slightly less total construction of federal public works in 1937.

1937 Developments

Authorization was given through legislative action in 1937 for the continuation through 1938 and 1939 of an extensive road program, both through grants-in-aid to states and for federal expenditure for grade-crossing elimination. The regulations under which these funds were expended were continued by the Bureau of Public Roads in substantial accordance with practices earlier established. After July 1, 1937, emergency funds for the grade-crossing program were discontinued, and specific appropriations for this purpose were made, to be expended as previously without matching requirements except that states or localities are required to pay for rights-of-way and damages accruing incident to the construction.

Legislation had been passed in 1936, authorizing the Reconstruction Finance Corporation to extend rehabilitation loans to municipalities and other governmental units for construction necessary as a result of flood damage. This authority was continued for

1937, and widened to authorize action in the event of other catastrophes. Because of restrictions difficult to meet, these loans were not extensively made. The Disaster Loan Corporation, set up under the Reconstruction Finance Corporation, was established primarily to insure rehabilitation loans to individual owners of damaged property.

The Wagner-Steagall Housing Act, to promote low-cost housing on a large scale through federal loans to municipalities, was passed in 1937, authorizing a $500 million slum-clearance and housing construction program to be expended in a period of three years. The loans may be made to local housing authorities to the extent of 90 per cent of costs, but the complexities and inconsistent requirements of the bill have delayed and made extremely difficult the adoption of administration rulings and interpretations. Enabling acts for local public housing agencies, although existing in many states, do not in all cases confer the necessary broad powers for carrying out the intent of the Act. Local subsidy requirements, even when satisfactory to local groups, have been difficult to meet, and by the end of 1937, although some of the funds were "earmarked," no contracts had been made and no construction begun.

Bills affecting the financial relationships of the federal government with states and municipalities in construction designed to eliminate stream pollution were passed by both Houses, but failure to agree in conference on the differences in the bills resulted in no legislation.

Most important 1937 development was the change in the position of the federal administration with respect to grants or loans for local public works of the heavy construction type. Early in the year the President indicated his conviction that the production of producer goods had outrun that of consumer goods. He urged a cessation of "pump-priming," and the Secretary of the Interior at that time declared that the pump had been primed so much that it had produced an "artesian well." Confidence that there was then no possibility of early recession seemed general in federal administration circles.

Inasmuch as authorization of federal participation in the financing of state and local public works has, from its inception, been on an emergency basis, and has been wholly subject to the direction of the President, immediate restriction of grants followed.

The President announced a policy of limiting grants on Public

Works Administration projects to 115 per cent of the amount expended for employment of relief labor, and denying allotment, in any event, if relief labor of appropriate skills were not available.

No grants were accepted under this arrangement. The President at this time suggested the possibility of diverting balances of Public Works Administration funds to low-cost housing construction. Presidential recommendation was made to Congress that no further specific authorization of funds be made for Public Works Administration projects, and that the agency be liquidated. When Congress passed the 1937 Emergency Appropriation Act, after much debate on the subject of further loans and grants, as well as on suggestions that Works Progress Administration projects be carried out only if local governments contributed 40 or even 50 per cent of the needed funds, $300 million was provided for Public Works Administration continuance, but no specific requirement was made as to sponsors' contributions on Works Progress Administration construction or other projects.

In the fight for continuation of the Public Works Administration, it was pointed out that many applications were in the hands of that agency for which local governments had spent large sums in preparation, and for some of which bond elections had been held. The bill, as passed, authorized allotments for such projects, and for certain other types, but definitely provided that no new project proposals were to be considered.

In September, expressing the opinion that the purpose for which the Public Works Administration was established had been accomplished, the President announced cessation of allotments.

As the year ended, in outlining his budget recommendations for the succeeding fiscal year, the President proposed that federal public works be also curtailed, in accordance with a policy which he now favors of varying public works activity according to government income. The President recommends continuation of the federal policy of cooperating with state and local governments in public works of the types which may be carried out through the Works Progress Administration. These expenditures, he believes, "though large in amount, can be reduced only by depriving a very large proportion of our population of benefits which modern civilization insists on."

The United States Senate has set up a Committee on Unemployment and Relief, which is studying all phases of that problem,

seeking to determine what policy may best be adopted to meet it. The economic recession of recent months is ascribed by some of the advisors of this Committee to the curtailment of government expenditure for heavy construction, and they urge its resumption.

It seems to be accepted, however, that planned and aided public works, while having a bearing, cannot be considered a major influence in this connection. Decision to maintain boom expenditure levels is held to mean continuation of deficit financing on the part of the federal government. Any public works program attempted as part of a plan to exert effect on stabilization of the national economic system must be federally financed. The timing of local public works is dependent upon local need and local financial consideration, and local experience has led to the rejection of the theory that contraction or postponement of normal public works during good times in order to provide for a concentration of activity in depression is either possible or desirable. And postponement cannot insure financing at the time of stress when the work is theoretically desirable.

For the past few years federal loans and grants-in-aid for state and local public works have been important and, in many cases, compelling factors. Finances of state and local governments have, during this period, shown general and marked improvement. This apparent improvement may be traced, in some cases, to deferred maintenance and other curtailment of normal functions decided upon in order to finance the requirements for the emergency programs.

In the Budget for fiscal 1938, which covers the period from July 1, 1937 through June 1938, estimates under recovery and relief headings had been reduced but general public works authorizations increased over those of the previous year. Estimates now presented for the year beginning with July 1938 recommend decreased federal general public works expenditures, decreased recovery and relief appropriations, and substantial decreases in other public works grants-in-aid.

Property Tax Limitations

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PROPERTY tax limitation, which was characterized two years ago as "probably the most serious immediate menace with which local self-government and sound public finance is faced at the present time,"[1] elicited considerably less interest and support in 1937 than it has commanded since 1932. This decline in enthusiasm has been generally attributed to improvement in the business situation throughout the first half of the year. The consequences of existing tax limitations, however, continue to harass public works officials and other administrators faced on the one hand with undiminished demands for public services and for adequate maintenance of existing public works and on the other hand with only a slight increase in revenues over the low levels established in 1935 and 1936 through the combined effects of property tax limitation and depression.

The establishment of upper limits for property tax rates or tax levies, by statutory or constitutional provision, has a long history, but achieved its most extensive development during the recent depression. Many observers during 1933, 1934, and 1935 wondered whether the movement would stop short of virtual destruction of the American traditions of local government and home rule. Events during 1937 indicate, however, that the flood of the tide has passed, at least for the moment. Although over one hundred property tax limitation laws were passed by twenty-six of the forty-five state legislatures meeting in regular or special session during the year, most of them liberalized previous powers to levy taxes, none of them established new over-all limitations, and none was passed by the legislatures of the six states[2] which were virtually free of property tax limitations at the beginning of the year.

Nor were any important constitutional amendments concerning property tax limitation placed before the voters or initiated by state legislatures in 1937.[3] On the contrary, the Massachusetts General

[1] *Editorial Comment*, National Municipal Review, Nov. 1935, p. 605.

[2] Connecticut, Delaware, Maine, Massachusetts, New Hampshire, and Vermont. The District of Columbia is also virtually free of maximum limitations on tax rates or tax levies.

[3] Georgia voters adopted, on June 7, a few amendments which carried property tax limitation provisions, but none was of more than local interest.

Court defeated a proposal for an amendment limiting property taxes to 2½ per cent despite an overwhelmingly favorable advisory vote cast in 39 of the state's 159 representative districts in 1936. The legislatures of Illinois, Nebraska, New York, Pennsylvania, Utah, and Washington also resisted demands for constitutional over-all limitation, while a bill for statutory over-all limitation died in the Connecticut General Assembly.

The outstanding legislative enactment of the year comes from Indiana. This act placed outside the tax limit levies for service of certain debts incurred since the adoption of over-all limitation in 1932, and raised the maximum property tax rate from 1½ per cent to 2 per cent within incorporated towns and cities and from 1 per cent to 1¼ per cent in rural areas. Most of the other property tax limitation laws of 1937 restrict the tax rate which can be levied by particular governments or classes of governments for the conduct of specified activities. A few concern the total tax rates of certain levels of government. On the whole, these laws display the same tendency to liberalize existing limitations as appeared in Indiana.

Definitions

It has been said that the mere publication of a definition lends it some sanction, if not sanctity, when the term defined has but recently attracted academic attention. Writers in the field of property tax limitation enjoy the freedom of an unstandardized terminology and readers in the field suffer commensurately. It therefore seems advisable to define our terms before proceeding further with this discussion, even at the risk of boring the reader with our Websterian mein.

Property tax limitation may be defined as a restriction imposed upon a legislative body by some higher legal authority precluding the legislative body from increasing indefinitely the amount to be raised in a single taxing period by a property tax whose rate or base is otherwise determinable by such body.[4] All limitations in current use are either rate limitations or levy (rate × base) limitations. They

[4] Strictly speaking, this is a "maximum" property tax limitation. Minimum property tax limitations also exist in many states, but are not generally included within the meaning of the term. A fixed tax rate does not qualify as a property tax limitation under the definition unless the tax base is subject to control by the legislative body levying the tax. Control of the tax base by local legislative bodies is so infrequent or so slight that it may be ignored for practical purposes.

may apply to taxes raised for a particular purpose (functional limitation), or to taxes raised for all purposes or for all except exempted purposes (non-functional limitation). They may apply to a single government or class of governments (jurisdictional limitation), or to all governments operating in a particular area (non-jurisdictional limitation).

Over-all property tax limitations, currently the most ardently sponsored but by no means the most common type, are usually rate limitations. They are by definition both non-functional and non-jurisdictional, that is, they restrict levies for all purposes, with minor exceptions, and of all governments, state and local, having jurisdiction within a given area. Levies for servicing debts incurred before adoption of a limitation measure are usually unrestricted, and there is some reason to think that failure to exempt such levies from limitation would be held unconstitutional as an impairment of contracts. Additional levies outside the basic limitation for specified or general purposes are usually permitted if sanctioned by the voters or by some other agency beyond the control of the ordinary tax-levying body. By sufferance, the laws of Rhode Island and Washington are termed over-all limitation laws even though a few exceptional and relatively unimportant tax districts are exempted from the limitation.

The number and variety of existing property tax limitations are so great as to defy interpretation in an article of the present scope. The Illinois Tax Commission recently devoted a 34-page report simply to an enumeration of the limitations of a single state, and an equally lengthy document would probably be required for several other of our mid-western states. Their interpretation and analysis would require a volume. For this reason, we will confine our attention largely to over-all property tax rate limitations.

History of Over-All Limitation

Over-all property tax rate limitation, despite its relatively recent claim upon the nation's interest, was neither conceived nor born during the recent depression. It has a history which goes at least as far back as 1878, when Rhode Island towns and cities were required to keep their tax rates within a limit of 1 per cent except in the event of certain emergencies. Massachusetts cities were limited to 1.2 per cent in 1885, with the exception of Boston, which was limited

to 0.9 per cent.[5] State-wide over-all limits of 5 per cent and 1 per cent respectively were enacted in Nevada (1895) and Illinois (1901), and a set of jurisdictional limits, which together comprised a relatively high over-all limit (3.15 per cent), was placed in the Oklahoma constitution of 1907. Ohio followed suit with a statutory limitation in 1910, superseded the following year by the famous "Smith one per cent law."

The succeeding thirty years saw a continuous liberalization of existing over-all limits. Ohio gave local electorates practically unlimited powers to vote additional levies, whereas they had originally been permitted to increase the levy only up to 1.5 per cent. Massachusetts removed the limitation from cities other than Boston in 1913, while Illinois amended its law so frequently that by 1929 it had no application outside Cook County and was practically a dead letter even in this restricted area.[6] The Rhode Island limit had been increased to 1.5 per cent in 1902, and was further increased to 2.5 per cent in 1920. Only Oklahoma's limitation, which was imbedded in the constitution, and Nevada's, which was so high as to be more or less impotent, remained unchanged during the period 1911 to 1932. Ohio's statutory limitation was, however, placed in the constitution in 1929 in conjunction with an amendment permitting classification of property for tax purposes.

In 1931, as depression-born demands for tax relief were arising on every hand, the movement for over-all limitation of property taxes gained new strength. Unlike the earlier phase of the movement, the drive this time was for constitutional limitation. The Kansas legislature proposed a constitutional amendment in 1931, but it failed of adoption in the general elections of 1932. In Michigan and West Virginia the campaign was more successful. Placed on the ballot in 1932 by popular initiative in Michigan and by the legislature in West Virginia, both measures were adopted in the fall of the same year. Two statutory over-all limitations were also adopted in 1932, one by the Indiana legislature and the other by the voters of Washington acting under their powers to initiate legislation. In the following year Ohio reduced its 1.5 per cent constitutional limitation to 1 per cent; Oklahoma amended its constitution by

[5] In the typical New England state, the tax rates of the towns and cities include the property taxes (if any) raised for higher levels of government, while minor tax districts are either exceptional or non-existent.

[6] Illinois Tax Commission, *Constitutional Tax Rate Limitation for Illinois*, Special Report No. 2, 1934, pp. 15-16.

reducing the basic over-all limitation to 1.7 per cent; and New Mexico adopted a constitutional limitation of 2 per cent.

Since 1933 the over-all property tax limitation movement has again been on the wane. In 1934 the Washington voters, by initiative, renewed and slightly amended their 2 per cent limitation,[7] and seven Michigan home-rule cities, exempted from the constitutional over-all limitation by court decision, voted to adopt the general limitation of 1.5 per cent. On the other hand, constitutional amendments were rejected in Colorado and Oregon, and one Michigan city rejected a charter limitation amendment. Four Michigan cities adopted and one rejected charter amendments in 1935, and the Nevada legislature initiated an amendment which, upon adoption by the voters in 1936, gave the 5 per cent limitation of 1895 the dignity and relative permanence of constitutional status. Over-all limitation disappeared in Massachusetts in 1936 with the removal of the Boston limitation. But the Washington statutory over-all limitation, expiring again in 1936, was renewed by initiative for another two years. In the same year the voters of Colorado, Georgia, Oregon and five Michigan cities expressed their disapproval of over-all limitation at the polls. By 1937 nine states[8] had over-all limits, but the movement gave every symptom of having run its course.

Effects of Over-All Limitation

Property tax levies. Early over-all property tax limitation laws were generally intended to stem further increases in property tax burdens; recently adopted measures have, instead, been designed to reduce property taxes. Local governments brought under these new measures were forced to slash their tax rates drastically. In the face of declining assessments induced by intensification of the depression, tax levies declined in even greater degree. In six out of the nine over-all limitation states,[9] general property tax levies in the aggregate declined 41 per cent, from $612,543,000 in 1931 to $363,396,000 in 1935.[10] Levies for 1936 and 1937 are not yet available for all states, but, on the basis of partial evidence and general observation, it appears that the first of these two years witnessed a further

[7] Actually 4 per cent on a 50 per cent statutory assessment level.

[8] Indiana, Michigan, New Mexico, Ohio, Oklahoma, Rhode Island, Washington, and West Virginia.

[9] Rhode Island and Nevada omitted because there has been no substantial change in their limitation laws in recent years; Ohio data unavailable for 1935.

[10] Due partially, however, to the withdrawal of intangibles from the general property tax base in Indiana in 1933.

decline in aggregate levies—albeit a slight one—as debts incurred prior to adoption of tax limits (which are generally serviceable outside the limit) were reduced and as assessed valuations responded sluggishly, if at all, to rising property values. The 1937 levies apparently increased somewhat because of higher assessed valuations and greater willingness of the public to vote levies outside the basic limitations.

Of course the levies of all governmental units were not decreased in equal percentage amounts. Governments which had accustomed themselves to high property tax rates, whether through necessity or otherwise, were hit exceedingly hard; the fortunate few were affected little or not at all. As a class, cities and school districts generally fared considerably worse than other levels of government, while rural counties and townships adjusted themselves to the new situation with relatively little difficulty. The plight of local governments depended in large part upon statutory allocations of the over-all limit to the various types of political subdivisions or upon the balance of power in county allocation boards. The state governments themselves, because of their greater command over replacement taxes, usually took the greatest cut in property taxes but suffered least of all.

Replacement Revenues. This tremendous decline in the general property tax revenues of local governments in over-all tax limit states sent them frantically forth in search of replacement revenues. In general they found that revenue sources subject to local control were few and relatively unproductive. Two West Virginia cities imposed retail sales taxes, but they were subsequently held invalid. Municipally owned utilities were forced to yield profits to the general fund, but in some states, notably Ohio, this was prohibited by law. Many activities previously financed out of taxes were placed on a special assessment or service charge basis. Thus one West Virginia city devised ingenious street lighting and police service charges which resembled combination poll and property taxes. Garbage collection fees and sewer rental charges were instituted in a number of cities and are still being seriously considered in many more. A few cities installed parking meters. Business licenses, utility franchise fees, and other minor government charges were increased wherever the opportunity for greater revenue presented itself. Delinquent property tax collections provided temporary alleviation of an otherwise desperate situation during the upswing of the business

cycle. Resort was even had to voluntary contributions in some West Virginia cities which would otherwise have been unable to carry on essential government functions.[11]

But the revenues which were added by local initiative were, on the whole, of little significance in the face of huge property tax losses, and were practically unavailable to local governments other than municipalities. The states were therefore called upon to afford relief by legislation opening new revenue sources to local governments and providing for state-collected, locally-shared taxes and grants-in-aid. Municipal liquor license fees were permitted in several states. Local governments in Indiana, deprived of general property taxes on intangibles in 1933, were given the major share of the state taxes subsequently collected on this type of property. Within the past year they have gained a larger share in motor vehicle registration taxes. In Michigan they have received part of the principal replacement revenue—the sales tax—in the form of grants-in-aid for schools and welfare activities, but much of the proceeds of this tax was required to replace the state property tax levy and to offset lower state property taxes on public utilities. The New Mexico net income tax, although adopted prior to over-all tax limitation, first began to yield revenue to the common school fund at about the time the schools felt the first impact of lower property tax levies. Sales tax receipts were also assigned to the schools, while the cities and counties were given certain liquor license fees. Ohio local governments, although the recipients of all or part of several minor state-collected taxes, were forced to rely heavily on a sales tax which produced much less revenue than was anticipated. The necessity for further aid forced a larger distribution of the sales tax early in 1938, supplemented by a gross earnings tax on utilities which is to be distributed to the counties for relief purposes. In Oklahoma, county governments profited by an increase in the gross production (mineral) tax, while much larger state grants-in-aid, especially for education, have been made possible by increases in net income tax rates and a new sales tax. Washington counties have received part of the state liquor taxes and licenses, and cities have gained a share in the gasoline and registration taxes. All of the West Virginia consumers' sales tax is used in support of local schools.

State governments, too, were forced to find replacement revenues

[11] S. E. Leland and R. J. Morthland, "Municipal Revenues," *Municipal Year Book, 1937*, p. 40.

as their property tax levies were reduced or eliminated. Being sovereign, no particular difficulty was encountered in providing substitute tax measures. The repeal of prohibition opened up a lucrative source of state revenue at about the time over-all limits were being adopted. At the same time, sales taxes were enjoying considerable popularity as taxes go, and each of the seven states which lost property tax revenues through new or lower over-all limits enacted some form of this relatively new tax. On the whole, the legislatures of these states looked with little favor on net income taxes, although such taxes produced a small amount of replacement revenue in New Mexico, Oklahoma, and West Virginia.[12]

The comparative ease with which state governments coped with tax limitation is evidenced by the fact that these seven over-all tax limit states increased their aggregate state tax revenues by 23 per cent between 1929 and 1935.[13] A large part of this increase filtered back to the local governments in the form of grants-in-aid or was used to administer functions formerly performed by local governments, but this fact is immaterial, since we are concerned at this point only with the question of available revenue sources and not with expenditures.

Aggregate revenue receipts. Replacement revenues apparently did not completely fill the gap left by declining property tax receipts. While 41 states, together with their local governments, collected taxes in 1935 amounting to 98 per cent of their 1929 taxes, the seven states affected by new or reduced over-all limits collected only 85 per cent. It is improbable that non-tax revenues changed this picture greatly. Among cities over 100,000, the seventeen subject to new or reduced over-all limits[14] collected taxes in 1935 amounting to only 79 per cent of their 1929 tax receipts, as compared with 112 per cent for the other seventy-seven cities over 100,000. If non-tax revenues be added to tax revenues, the percentages are 81 for the seventeen cities and 115 for the others.

These figures appear to call for some qualification of the contention that property tax limits fail to reduce or limit revenues. As

[12] A. Miller Hillhouse and Ronald B. Welch, *Tax Limits Appraised*, Public Administration Service, Chicago, 1937.

[13] National Industrial Conference Board, *Cost of Government in the United States, 1394-1936*, New York, 1937, p. 52.

[14] Cleveland, Seattle, Indianapolis, Columbus, Toledo, Dayton, Oklahoma City, Youngstown, Flint, Tulsa, Fort Wayne, Spokane, South Bend, Tacoma, Gary, Canton, and Evansville.

most of those who make such statements are doubtless aware, there is a period of greater or lesser duration in which revenues are reduced, but there is considerable evidence that demands for governmental expenditures eventually break down the barriers and force resort to replacement revenues. Evidence of the latter tendency is sound in the statistics for cities over 100,000. The seventeen cities which were under recently adopted over-all limits in both years increased their aggregate revenue receipts by 14 per cent between 1935 and 1936, whereas other cities over 100,000 decreased theirs slightly. The tax-limit cities were, however, still substantially below their pre-tax limit position relative to other cities in this population group.

Expenditures. Declining aggregate revenues may be met either by a reduction in expenditures or an increased public debt, or both. Over-all tax limitation during the recent depression seems mainly to have affected expenditures.

If anyone was naive enough to believe that expenditures could be reduced in the required amounts simply by pulling sticky fingers out of the public purse, they were soon disillusioned. Tax limitation meant not only large cuts in salaries and wholesale discharge of employees, but also a severe curtailment in services. School terms were shortened, curricula were narrowed, and schools were closed temporarily during their regular terms; fire fighting forces and equipment were so depleted that underwriters re-rated cities and raised insurance rates; street lights were reduced or turned out completely; streets were allowed to go dirty and to fall into disrepair; garbage collection schedules were revised downward; recreational programs were discontinued; and capital expenditures virtually ceased.

Many of the more spectacular of these curtailments have been reported in the literature of tax limitation—the closing of the schools in Springfield, Ohio; the discharge of the mayor, the council, and all municipal employees, except those in the water department, in Wheeling; the emptying of the jail in Wyoming County (W. Va.); the complete cessation of local government in Marfrance (W.Va.); the removal of all betterments from the Seattle budgets of 1934 and 1935, to mention only a few. Most of these conditions, it is true, were so intolerable that means were soon found for their alleviation. But a low level of government service still exists in many municipalities. After several years of over-all limitation in

West Virginia it was reported that municipalities were spending 50 per cent less than in pre-tax limit years on street lighting, 30 per cent less on fire protection, 25 per cent less on police protection, 80 per cent less on sewer maintenance, 65 per cent less on sanitation service, and 70 per cent less on street repairs.[15] And these are average figures which obscure the low levels of service in the "sub-average" cities which exist in large numbers despite the attempt of proponents of uniform limitation to ignore them.

The principal defense of over-all tax limitation lies in the possibility that these reductions represented a curtailment of extravagance and waste. This is, of course, impossible to prove or disprove. There are no statistical devices by which to measure the relative worth of various dollars of expenditure in the same activity, much less the relative worth of dollars spent on different activities. It is reasonably certain, however, that a constructive approach to expenditure control must come through such things as governmental reorganization, improved budgeting and budget control, centralized purchasing, an intelligent personnel administration, good accounting and reporting systems, careful auditing, and better control over indebtedness. None of these is directly promoted by tax limitation; in fact, they are jeopardized by added incentives to incur debts, weakening of public interest in budgets, and reluctance to make the initial investment in new personnel and higher salaried officials and consultants out of which the savings must spring. Most commentators contend that the end result of over-all tax limitation is to increase, rather than to decrease, public spending.

Indebtedness. Revenue losses which are not met by reduced expenditures must be met by increased borrowing. It has long been assumed that greater borrowing is an inevitable consequence of severe property tax limitation. Overwhelming evidence of this effect is found in the early history of Ohio, where it is estimated that over 50 million dollars worth of bonds were issued to finance current expenditures before the tax limitation was relaxed.[16] The experience of Massachusetts and Rhode Island also demonstrates this tendency, tempered, no doubt, by the traditional New England thrift. But

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[15] The West Virginia League of Municipalities, *News Bulletin*, Nov. 17, 1937.

[16] R. C. Atkinson, "Stringent Tax Limitation and Its Effects in Ohio," *Property Tax Limitation Laws*, edited by Glen Leet and Robert M. Paige, Public Administration Service, 1936, p. 71.

recent years have failed to add substantially to this evidence.

In most states and on most levels of government, indebtedness tended downward throughout the depression. The tax-limit states have been no exception to the general rule. In fact the seventeen over-all tax limit cities with populations of 100,000 and over reduced their aggregate net funded and floating debt in each year from 1932 through 1935. Each of the cities except Columbus and Youngstown had a lower net debt at the end of the period than at the beginning, a fact the more surprising because it is well known that several large Ohio cities have been resorting to deficiency bonds in recent years.[17] Furthermore, the other seventy-seven cities over 100,000 showed a continuous growth in indebtedness over the same period.

There are several possible explanations of this paradox. It may be that early experience under over-all limitation was colored by inadequate laws governing local budgets and debt limitations. It is possible, too, that rising assessed valuations led to the assumption that an increasing public debt could readily be serviced under existing tax limits. Furthermore, there were no restrictions upon levies for debt service in Rhode Island and relatively less restriction upon such levies than upon other levies in Ohio from 1923 to 1933,[18] whereas recent over-all limitation laws have generally permitted unlimited levies only for service of debts incurred before the adoption of the limitation. Finally, some of the failure to incur new indebtedness in the past few years may have been forced by poor credit ratings and the exhaustion of borrowing capacity under debt limitation laws. It is entirely possible, if not probable, that municipalities with restricted property tax rates will again resort in large measure to borrowing when an easy bond market, rising assessed valuations, and a boom psychology have fully replaced the conditions of the past five years. Especially is this to be anticipated in Indiana, where levies for service of new indebtedness are no longer necessarily subject to the tax limit.

Functional transfers. The converse of increased state grants and shared taxes is a transfer of functions from local to state governments. Aside from welfare activities, whose transfer was probably otherwise motivated, the principal shifts occurred in the field of

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[17] New York State Commission for the Revision of the Tax Laws, *Experience with Overall Tax Limitation Laws,* Eighth Report, Jan. 1937, p. 21.

[18] A. Miller Hillhouse and Ronald B. Welch, *op. cit.,* pp. 23-24.

highways. The state took over all county and district roads in West Virginia. In Oklahoma, townships were abolished and roads under their jurisdiction were transferred to the counties and financed in part by a share in the state gasoline tax. The construction and maintenance of county roads in Washington have been taken over by the state. None of these transfers, it will be noted, affected city streets; in general they have remained under local control with co-operative financing by means of shared state gasoline and registration taxes.

Government credit. The credit of governments subject to property tax limitation has suffered badly wherever principal reliance for revenues is placed upon this tax source and the limitation is severe. The best statistical proof of this obvious and oft-repeated statement comes from Indiana. Until recently, indebtedness was serviceable within the tax limit if incurred after August 8, 1932, and outside the tax limit if incurred before that date. Refunding bond issues were subject to the limitations applicable to the bonds refunded. A comparative study of new and refunding issues of approximately the same date showed a decidedly lower effective interest rate on the refunding issues serviceable out of unlimited tax levies.[19] For example, one school district sold an issue of so-called "unlimited" tax bonds on March 1, 1936, and an issue of "limited" bonds on the same day. The unlimited bonds sold to yield 3.22 per cent, while the limited bonds sold to yield 3.75 per cent. The evidence accumulated in the course of this study was apparently convincing to the legislature, for a few months after its publication the Indiana tax limit was amended to exempt levies for future, as well as past, debt.

Other effects. Several other minor effects may be mentioned with little or no comment. Assessments in some instances were increased in order to permit a higher tax levy, but little evidence in support of the contention that tax limitation produces greater equity in assessments has been forthcoming. Tax delinquency has been reduced in over-all tax-limit states, possibly in greater measure than elsewhere. On the other hand, budgeting has undoubtedly suffered, both because of the lessening of interest in this phase of public administration in the face of what is commonly thought to be an effective check upon an excessive budget, and because of the tre-

[19] Harry T. Ice and Mayburn F. Landgraf, "One Result of the Dollar and One-Half Law," *Indiana Law Journal*, Dec. 1936, pp. 133-143.

mendous complication of the budgeting process, especially in West Virginia and in states having a maze of jurisdictional and functional limitations in addition to an over-all limit.[20]

Tax Limits and Public Works

An examination of the financial statistics of cities over 100,000 has been made to determine the extent to which operation and maintenance expenditures of public works departments in cities recently brought under over-all property tax limits have been affected thereby. For the purpose of this analysis, all expenditures for sanitation, highways, and water works were assumed to be public works expenditures. The aggregate dollar expenditures on each of these functions by the seventeen cities brought under new or more severe over-all limits between 1932 and 1935 were expressed in index form, using 1930 expenditures as a base, and were compared with similar data for the remaining seventy-seven cities over 100,000. The results are shown in the following table.

	1930	1931	1932	1933	1934	1935	1936
			17 over-all limit cities				
Sanitation	100	97	81	66	64	66	80
Highways	100	99	78	70	74	64	84
Water works	100	109	87	78	85	90	—
			77 other cities				
Sanitation	100	97	93	78	72	74	75
Highways	100	96	90	77	77	78	74
Water works	100	104	97	85	86	90	—

These data evidence substantial declines in operation and maintenance expenditures of public works departments beginning in 1932, both in the over-all tax limit cities and elsewhere. The drop was considerably greater through 1935 for tax-limit cities, except in the case of waterworks, where a substantial differential in favor of the seventy-seven cities obtained only during 1932 and 1933. The sudden rise in operation and maintenance expenditures on sanitation and highways in 1936 among the over-all tax limit cities is difficult to explain, but may possibly be attributable to the cumulative effect of under-maintenance during the preceding four years. The failure of over-all tax limits to affect adversely the operation and

[20] Carl H. Chatters, "Budgets Under Specific Tax Limits," *Property Tax Limitation Laws*, edited by Glen Leet and Robert M. Paige, pp. 29-30.

maintenance of waterworks is understandable, since they are generally self-supporting and more or less insulated from the effects of tax limitation.

New methods of financing public works operations have helped to maintain public works expenditures at a much higher level than would otherwise have been possible. Sewer rental and garbage collection charges and special assessments for maintenance have spread rapidly, and highway expenditures have been financed in increasingly large degree out of state grants and shared gasoline and registration taxes earmarked for this purpose. Finally, a large amount of W.P.A. labor, which is reflected in municipal expenditures only to the extent of the sponsor's contributions, has been used for public works maintenance.

Capital outlays, on the other hand, have been drastically cut as a result of over-all limitation, and public works outlays in at least one field have suffered commensurately. Using the same index as for operation and maintenance expenditures, the position of the seventeen over-all limitation cities and of the seventy-seven other cities was as follows:

	1930	1931	1932	1933	1934	1935
			17 over-all limit cities			
Sanitation	100	99	91	28	40	74
Highways	100	74	35	12	9	14
Water works	100	82	50	40	45	35
			77 other cities			
Sanitation	100	78	45	24	41	44
Highways	100	70	44	25	25	20
Water works	100	80	46	23	30	30

Surprisingly enough, these data indicate that outlays on sanitation and waterworks stood up better in over-all tax limit cities than elsewhere during the depression. This situation may have been peculiar to cities over 100,000; or it may have been attributable to a greater tendency in tax-limit cities to place sewerage and waterworks systems on a self-liquidating basis, thereby qualifying them for loans from the federal government. And, of course, the aggregate figures obscure the serious declines which have occurred and persisted in some cities.

The decline in outlays in all cities has been considerably mitigated by P.W.A. loans and grants. Federal grants for public works among

the seventeen over-all tax limit cities alone accounted for 21 per cent of their aggregate capital outlays for public utilities and general departments in 1936. But the current outlook is for substantial curtailment of federal grants of all character.

It is of special importance that the operating funds of the public works department be maintained at adequate levels. The public has made a tremendous capital investment in its streets and highways, sewerage systems, waterworks, and other public utilities. Failure to maintain such properties hastens their deterioration and results in serious capital losses which can be made good only with expenditures far exceeding the sums required for maintenance. A number of cities have reported cases of capital loss as the result of undermaintenance and more will, in all probability, be added to the list in ensuing years. This is one of the most obvious examples of a penny-wise-pound-foolish attitude on the part of those who support the tax limitation movement.

The failure to make new capital outlays may be less serious. The most that the public can lose is the value of the services which would flow from the capital assets acquired. In some instances such services may not be worth the price; in others they may be worth much more than they cost. At all events, the decision should rest with the governments concerned and not with a state legislature or with the dead hand which writes the constitution.

The Gasoline Tax[1]

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THE GASOLINE TAX was first adopted in February 1919, when the legislature of Oregon passed a bill which authorized the collection of a one-cent tax. The provision for a tax on gasoline was made to provide resources for the maintenance of highways which were to be constructed from a $10,000,000 bond issue. From this beginning in 1919, the gasoline tax has spread to every state of the

[1] See also *The Gasoline Tax in the United States: 1936*. By Finla G. Crawford. Public Administration Service, Chicago, 1937.

Union, to the District of Columbia, and the federal government. Rates have been raised steadily until the modest one-cent rate has disappeared and in only one state—Missouri—and the District of Columbia is the rate two cents per gallon. The three-cent rate is to be found in ten states,[2] and all the remainder collect four, five, six, and in three states—Florida, Tennessee, and Louisiana—a seven-cent tax is collected. During 1937 the legislatures of four states made increases in the gasoline tax. In West Virginia a tax increase went into effect April 1 which made the tax five cents per gallon. This, however, is a temporary one-cent tax to be effective until July 1, 1939, when it reverts to four cents. Rhode Island increased the rate on April 21, 1937, from two to three cents, to be in force until June 30, 1938. This left Missouri as the only state with a two-cent rate. The increase from three to four cents in Minnesota was effective April 23, 1937, the additional tax to remain in effect until July 1, 1939. New York, the fourth state, added one cent to make a four-cent tax rate, to be collected until June 30, 1938, unless the 1938 legislature makes an extension for a second year.

The Missouri legislature passed an act which will be effective December 8, 1938, if approved by the voters at the general election in November 1938. By this action, the gasoline tax rate will be increased to three cents. In 1928 the voters of Missouri passed a constitutional amendment setting the tax rate at two cents for a period of ten years. The first opportunity to increase that rate will be the general election of 1938.

These advances in tax rates are significant because at the close of 1935, the tide seemed to have set in against further tax increases. The changes in 1937 demonstrate the popularity of the gasoline tax as a revenue producer and indicate that the end of tax increases is not yet in sight.

In twelve states temporary taxes are in effect, as indicated by Table I below. The existence of these temporary taxes is indicative of the fact that the legislatures are unwilling to make permanent increases and apparently believe that the gasoline tax should be stabilized at a lower rate.

The proceeds from the state gasoline tax have mounted with great rapidity from one million in 1919 to $683,000,000 in 1936. The federal tax provided a collection of $196,000,000 in that year,

[2] California, Connecticut, Illinois, Massachusetts, Michigan, New Jersey, North Dakota, Rhode Island, Iowa, Kansas.

so that the gross gasoline tax collections for 1936 amounted to $879,000,000.

TABLE I. TEMPORARY GASOLINE TAXES IN EFFECT JANUARY 1, 1938

State	Rate	Expires
Florida	1¢	June 30, 1939
Massachusetts	1¢	April 30, 1939
Minnesota	1¢	July 1, 1939
Montana	2¢	February 28, 1941
Nebraska	1¢	June 30, 1939
New Hampshire	1¢	When certain bonds are paid
New York	2¢	June 30, 1938
Ohio	1¢	March 31, 1939
Pennsylvania	1¢	May 31, 1939
Rhode Island	1¢	June 30, 1938
Tennessee	1¢	When certain bonds are paid
West Virginia	1¢	June 30, 1939

The first gasoline tax laws were simply drawn and easily administered. The tax was a novelty, the rates were low, and the small number of taxpayers made the tax collection process easy. As the tax spread over the United States, problems of administration became more and more complicated. Tax evasion became profitable with the rapid increase in rates, and bootlegging was extended to a marked degree. Loopholes were discovered in the laws, and the legislatures were forced to add many provisions in order to combat the evasion practices. Many of these new provisions were welcomed by the honest distributors, although they were irked by the red tape which seemed necessary to check and control their less scrupulous brothers. The staff necessary to collect the tax had to be increased, but because of sharply increased collections, the costs for each dollar collected were very low. Not only did the problems of administration increase with rapidity, but three additional matters became of extreme importance—namely, the question of refunds and exemption, the distribution of the proceeds, and diversion of gasoline tax moneys to purposes other than highways. These three problems have occupied most of the space which has been devoted to the discussion of the gasoline tax, and they are of importance to the public works field.

REFUNDS AND EXEMPTIONS

The problem of refunds and exemptions is one of the most perplexing problems facing the tax administrator. The reason for

refunds and exemptions arises from a consideration of the purpose of the gasoline tax. The framers of the original Oregon statute conceived the tax as a means of providing a fund for highways. The idea has been continued and it was well expressed in the New York law of 1929 as follows[3]:

> However the intention of this article is to place the ultimate burden resulting from such tax, so far as possible, on persons who use the public highways of the state for operating motor vehicles thereon, and the following refunds are provided to that end. . . .

It is unnecessary to cite all the varying provisions of the statutes in regard to refunds and exemptions. A large amount of experimentation has been followed by various states in an attempt to work out a satisfactory means of preventing misuse of refund and exemption provisions of the statutes. Twelve states allow no exemptions or refunds, and the other thirty-six jurisdictions allow refunds or exemptions in one form or another. In some cases they allow both. The Kansas statute is alone in granting exemptions under the following terms:

> *Sec. 18.* Any person who shall use any motor vehicle fuels for any purpose other than operating or propelling motor vehicles on public highways may, upon obtaining an exemption permit, and complying with the conditions specified herein, purchase motor vehicle fuels for such use in quantities of forty (40) gallons or more, and such purchases shall be exempt from the payment of the tax herein provided.

In 1937 fewer changes were made in refund and exemptions than in previous years. New Hampshire specifically provided for refunds for gasoline used in tractors, while Rhode Island granted refunds for gasoline used in tractors under the condition that the tractors are recorded by owners thereof with the motor vehicle department of the state board of public works. The opinion might be ventured that experience had demonstrated the need and workability of the present refund provision and that no further changes were demanded or desirable.

Distribution

The table below tells the story of distribution of the gasoline tax over a period of ten years, 1927-1936. An examination of this table, based on the published records of the Bureau of Public Roads, is

[3] New York Cons. Laws, Art. 12-A, Sec. 289-c, par. 2.

most revealing. In this ten-year period, state highways have received a decreasing percentage of the total amount collected from the gasoline tax. In 1936 this percentage was an all-time low of 42.3, although the total amount increased over 1935. Local roads have held to approximately the same percentage, although the amounts have increased. Municipalities, after a very slow start, have developed an agitation in favor of a better split from the gasoline tax. In this they have been successful, both in terms of percentage of the whole amount and the total received.

TABLE II. DISTRIBUTION OF GASOLINE-TAX REVENUES BY PURPOSES, ALL STATES

	State Highways	Per Cent	Local Roads	Per Cent	City Streets	Per Cent
1936[a]	$289,214,000	42.3	$131,205,000	19.2	$28,770,000	4.2
1935	261,321,396	42.8	123,420,040	20.2	20,855,123	3.4
1934	251,509,072	44.8	112,916,486	20.1	18,862,763	3.4
1933	277,517,371	53.4	111,109,158	21.4	13,334,180	2.5
1932	301,788,231	58.6	94,073,954	18.3	18,262,986	3.5
1931	354,017,281	66.0	100,073,959	18.6	20,976,846	3.9
1930	338,927,564	68.6	96,225,637	19.4	13,264,244	2.7
1929	297,967,756	68.0	85,113,708	19.7	14,548,106	3.3
1928	211,046,591	69.4	57,380,901	18.8	9,093,867	2.8
1927	182,095,503	70.7	55,440,161	21.0	3,619,388	1.3

	State and County Bonds	Per Cent	Miscellaneous	Per Cent	Total
1936	$104,713,000	15.4	$129,172,000[b]	18.9	$683,074,000
1935	93,601,974	15.3	111,246,201	18.0	610,444,734
1934	88,247,391	15.7	89,630,406	16.0	561,166,118
1933	61,235,394	11.8	53,488,050	10.3	518,195,712
1932	50,726,362	9.8	46,289,444	9.0	513,047,239
1931	44,450,058	8.2	18,081,201	3.3	536,562,880
1930	31,049,036	6.3	13,907,302	2.8	493,657,977
1929	23,371,785	5.4	9,856,921	2.2	431,311,519
1928	17,619,995	5.7	9,397,887	3.0	304,871,766
1927	10,086,456	3.8	7,225,140	2.7	258,838,813

[a] Includes $1,059,000 expended for park and forest roads.
[b] Includes administrative expense $6,227,000 and $3,537,000 state highway police.

The pressure of the municipalities to share in the proceeds from the gasoline tax has come from the real property owners who have sought all means of relief from their burdens and as well from the city planners who see the need for larger and larger expenditures to provide boulevards and main arteries to handle the volume of municipal traffic.

Cities may profit from the gasoline tax in one of three ways.

In the first place, they may receive a portion of the revenues collected. This may come through a direct expenditure by the state within the city or it may be received as a cost apportionment. More and more there has been an inclination to use the first method because the state felt the necessity of financing that portion of the city streets which were an integral part of the state highway system. In many states, a program of building cut-offs around cities has speeded up through traffic. This has also eliminated the necessity of state aid for city streets. In the second place, cities may be granted the privilege of collecting a tax in addition to the tax collected by the state. The year 1937 saw no rapid increase in municipal gasoline taxes. Finally, the cities may be exempted from paying the tax on gasoline used in city-owned vehicles. In Colorado, Delaware, Michigan, New Jersey, New York, Rhode Island, and Virginia, refunds are allowed on purchases by municipalities.

In the last two items of the table, the most significant developments are to be observed. The increase in the expenditures for state and county highway bonds has jumped both in terms of percentage and in total amount. Ten years ago 3.8 per cent was expended for bonds, as against 15.4 per cent in 1936. The total increased from ten million to over one hundred million. The use of the gasoline tax to finance the payments of past road construction has attracted the attention of legislatures. It is a relatively sure way of financing a bond issue and receives support from most groups, including those most vitally affected by the tax. In two states—New Hampshire and Tennessee—temporary taxes are in effect which do not expire until the bonds for which they have been issued have been paid.

The final heading, that of "Miscellaneous," continues to advance both in terms of percentage and in total amount. This will be discussed under diversion.

The gasoline tax was devised for the construction and maintenance of a highway system, and ten years ago 93 per cent of the total collected was utilized for that purpose. In 1936, only 65.7 per cent of this total amount was used for current construction while an increasing amount went to pay for past highway obligations. Nearly one-fifth was used for miscellaneous purposes, outside of any possible range of interest of those who initiated gasoline taxation. The bond and miscellaneous commitments for gasoline tax proceeds have become established. The year 1937 did not halt the trend, but

rather served to establish it more definitely. The future of the gasoline tax as a means of financing new construction and rebuilding old routes is distinctly imperiled.

Diversion

When the gasoline tax was enacted in 1919 by the Oregon Legislature, the proceeds were to be used for the construction and maintenance of a state highway system. As other state legislatures adopted this form of taxation, it was generally understood that the motorists would receive the benefit in the form of improved highways. The money collected was allocated to state highway departments or to county highway uses. Refunds were paid only when the gasoline was not used on the highways. The gasoline tax was approved by the motorists, and in most states the automobile associations favored increases in rates because of the demand for better roads. The use of gasoline tax money for purposes other than street or highway construction and maintenance has generally been labeled "diversion," although no formal definition of that term has been agreed upon by students of gasoline tax problems.

As a matter of fact, members of state legislatures faced on the one hand with a near revolt from the property taxpayers, and on the other by a demand for larger appropriations, turned to the gasoline tax as a never ending source of revenue. The tax seemed to be fool-proof; the costs of collection were low, and the tax-bearer paid the tax as a part of the price of gasoline. The demand for gasoline did not shrink with increased rates because at the same time that tax rates were going up, competition in the industry was forcing the price of gasoline down. The tax was paid in driblets. Everything conspired to make this source of revenue ideal for diversion. The drive to use gasoline tax proceeds for purposes other than highways began prior to 1927, but the depression furnished the real impetus as an examination of the figures in Table III, page 62, will indicate.

The general fund of the states and payments on general fund bonds received almost half of the total amount diverted in 1936. Relief and education ranked next in order, the former having increased from $15,500,000 to $28,865,000 in the year. If these three items should be eliminated, the amount of diversion would be negligible. The defect of this analysis is the inability to trace down the exact use of the money which has been allotted to local roads.

In some cases, it has been made public that the local unit's share of the gasoline tax has been spent for purposes other than highways. The exact amounts are impossible to secure.

TABLE III. DIVERSION OF GASOLINE TAX REVENUES, 1927-36

	Amount Diverted	Percentage of Total Resources
1927	$ 5,296,921	2.04
1928	7,860,516	2.57
1929	9,260,562	2.14
1930	13,907,302	2.81
1931	18,081,208	3.37
1932	46,289,444	9.02
1933	53,488,050	10.32
1934	89,630,046	15.85
1935	111,246,241	18.03
1936[a]	129,172,000	18.90

[a] An analysis of the 1936 diversion shows the following allocations:

General Funds	$51,831,000
Relief	28,865,000
Education	28,290,000
General Fund Bonds	6,298,000
Administrative Expense	6,227,000
State Highway Police	3,537,000
Real Estate Bonds	2,131,000
Harbors	955,000
Construction Bonds	486,000
Park Bonds	242,000
Aviation	149,000
Commerce and Navigation	90,000
State Departments	49,000
Ferries	14,000
Irrigation	7,000
	$129,172,000

The amount of money diverted for purposes other than highway construction varies according to the basis on which calculations are made. In a 1937 publication, *Petroleum Facts and Figures,* a table shows the total diversion of petroleum and automotive taxes from 1925 to 1936. These figures, including the license fee and miscellaneous taxes as well as the gasoline tax, indicate that $169,344,000 was diverted in 1936. This differs from the table shown on page 9 by $40,000,000, but a breakdown is not available to indicate exactly how this result was arrived at. The analysis made in Table I does not include amounts spent on city streets as a diversion, although some writers have included these items as such.

The move for diversion of gasoline tax funds met with strong opposition in 1937. The American Automobile Association, in a

booklet entitled *Motor Vehicle Taxes* stated that ". . . . the revenues from special motor vehicle fees and gasoline taxes should be dedicated exclusively to highway purposes." They maintain that there should be adopted in every state appropriate provisions to prevent the diversion of motor vehicle revenue to other than highway purposes.

Pointing out that increased automotive traffic and greater problems of highway safety, arising from such increased traffic, demand adequate and continuous state programs of highway construction and maintenance, the eleventh National Asphalt Conference held in Memphis, Tennessee, passed a resolution condemning the diversion of automotive tax funds to purposes other than highway financing. The conference was held under the auspices of the Asphalt Institute. The resolution reads as follows:

> Several states have incorporated in their constitutions prohibitions against diversion, or are initiating the adoption of similar constitutional amendments. Continuation of diversion, which during 1936 totaled $169,-344,000, is unsupportable in principle and in violation of the purposes for which special additional taxes are imposed upon highway transportation.
>
> Therefore, be it resolved by the National Asphalt Conference that the members of the legislatures in those states where diversion is not prohibited be petitioned to enact legislation designed to prohibit such diversion by a constitutional amendment.

Diversion has aroused the activities of many groups and the opposition has been effective in securing legislation to prevent spending of gasoline tax proceeds for purposes other than highway construction and maintenance. Five states—Colorado, Kansas, Maine, Minnesota, and Missouri—have constitutional or statutory basis adopted prior to 1937, prohibiting the practice. In 1936, Maine by a popular vote of three to one, outlawed such diversion by the state. That state has never practiced diversion, but the voters of that state were positive in their opposition.

In 1937 anti-diversion constitutional amendments were introduced and considered in twenty states, and received affirmative action in Alabama, California, Indiana, and Nevada. Each of these must be voted on by the electorate, and each would make it unlawful for the legislators of the future to divert the motorists' taxes by expending the revenues except for highway purposes.

Petitions were circulated in Massachusetts seeking to bring about

an amendment by referendum. Nearly 150,000 electors of the state signed, but the Supreme Court of Massachusetts ruled that an amendment to the state constitution pertaining in any way to an appropriation could not be initiated by popular petition. Anti-diversion statutes were enacted in Alabama, Indiana, North Dakota, and Washington. In South Dakota a law was enacted which rescinds the diversion of two cents per gallon on the gasoline tax to retire rural credit bonds. Diversion was materially reduced in Arkansas, Washington, and Maryland. At the end of 1937 there were twenty states which did not divert gasoline tax revenue, twenty-seven states which did not divert registration fees, and thirteen states had no diversion at all. The position taken by most anti-diversion advocates is based on the theory that taxes collected by a government in the role of a proprietor should be used exclusively to pay the cost of the service rendered. The anti-diversion supporters maintain that the misuse of highway funds results in widespread neglect of roads and an increase in the hazards of motoring.

Congress, as well as the state legislatures, has taken official notice of diversion. The Hayden-Cartwright Act of 1934 included a provision of special importance to the motor vehicle owner. Section 12 of the Act states:

> Since it is unfair and unjust to tax motor vehicle transportation unless the proceeds of such taxation are applied to the construction, improvement, or maintenance of highways, after June 30, 1935 Federal aid for highways shall be extended only to those states that use at least the amounts now provided by law for such purposes in each state from state motor vehicle registration fees, licenses, gasoline taxes and other special taxes on motor-vehicle owners and operators of all kinds for the construction, improvement, and maintenance of highways and administrative expenses in connection therewith, including the retirement of bonds for which such revenues have been pledged, and for no other purposes, under such regulations as the Secretary of Agriculture shall promulgate from time to time; PROVIDED, That in no case shall the provisions of this section operate to deprive any state of more than one-third of the amount to which that state would be entitled under any apportionment hereafter made, for the fiscal year for which the apportionment is made.

This was the first official recognition given by the federal government to the principle that the diversion of motor vehicle taxes to any other than highway purposes is a discrimination against the motor vehicle owners as a class. It was obviously inserted for the purpose of discouraging such diversion. This theory is carried on

in principle in the Hayden-Cartwright Act of 1936, which also provides that if, in any state within the fiscal years 1936 and 1937, proceeds of all special taxes on motor vehicle transportation have been applied to highway purposes and there is insufficient balance for matching purposes, ". . . . all, or such portion as the state is unable to match, shall be available for expenditure . . . . without being matched with state funds."

Some authorities on public finance do not admit that diversion constitutes a problem. Granting the historical background of gasoline tax legislation, they see the tax now as an accepted source of public revenue, and they feel that if at any time relief or education demands more public financial support, the states should be free to apply all available revenues where the need is greatest. Many authorities are disturbed by the system of earmarking certain revenues specifically, either in whole or in part, even granting that amounts equivalent to those collected from the gasoline tax should be appropriated for highway purposes. These students are eager to see comprehensive state budgets instituted, and in states where such systems are being developed, they feel that on principle all revenue should be placed in the general state fund. However sound these positions may be in theory, the fact remains that most gasoline-tax laws have earmarked the revenues for highway purposes and diversion may, therefore, be considered a problem in gasoline-tax administration of particular interest to the field of public works.

Conclusion

Although no figures have been released on the collections from the gasoline tax for 1937, it has been predicted by various authorities that the total amount will greatly exceed the $683,000,000 of 1936. There is some likelihood that collections will go over $700,000,000 due to increased travel and the increase in rates. Diversion for 1937 will apparently remain at approximately the same figures as in 1936, although in terms of percentage there will be a decrease. The great test will come in the legislatures of 1938 in regard to rates, distribution policy, and attitude toward diversion. With the gasoline tax moving into its twentieth year of operation, the time has arrived for a higher degree of stabilization.

Planning and the Engineer

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CITY PLANNING in many places has been erroneously confused with Civic Planning and consequently construction and maintenance engineers have too frequently felt it was not a field in which they had any interest or knowledge. That confusion is also the reason so many planning commission budgets were eliminated or curtailed during the lean tax collection years. This fallacy must be corrected. City Planning by its very nature is no more Civic Planning than are physical or economic planning. In fact, Civic Planning or Civic Pride is the result of proper physical and economic planning. City Planning makes Civic Planning possible. Both require engineering and engineers. Maintenance engineers and construction engineers will find work much easier when a city plan has been adopted.

The human body requires circulation of blood for existence. Stop the flow of this blood to a part of the body and that member no longer functions; if the flow is retarded, the member's usefulness is impaired. Cities require circulation of traffic, water, sewage, gas, and electricity. If the flow of any one of these is impaired or stopped, that portion of the city depending upon it is retarded or made useless and is a drag upon the rest of the city. Values sag, slums are born, and the cost of maintaining a sick neighborhood greatly exceeds its worth. Experience has shown that not until neighborhoods have become sick do the public and public officials

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consider the need of planning. The old saying that an ounce of prevention is worth a pound of cure is demonstrated by city planning. At this time, in most places only corrective planning can be done and at great cost, with results not so satisfactory as they would have been had an orderly plan been followed from the beginning.

It is obvious that transportation is essential to industry. Without it, raw materials cease coming, products pile up at the shipping dock, even workmen cannot get to and from work. Business areas find that business suffers if they are difficult to get to. The same service is essential to residential areas.

In addition, such areas need many other things: schools are necessary, recreation must be provided, and land use must be regulated, to stop the selfish from using property to the detriment and financial loss of those already established. Police authorities have found that in those districts in which schools and recreation facilities are adequate, crime is noticeably less than in other districts. Crime prevention costs much less than crime control. Because of the lack of planning in the past, cities are now faced with huge expenditures to buy land for widening of streets, acquisition of playgrounds, parks, and school sites that could easily have been anticipated if a plan had been made. They are faced with expenditures for reconstruction of water mains, sewers, and public utilities installed when the change in the character of the use of land was not anticipated. Most of those changes have been brought about by individuals seeking only their own profit, and have resulted in expense to the public. Much of this could have been avoided if a plan had been made and carried out with the control a good plan carries with it. Every dollar spent by a public utility means six to eight cents per year out of some user's budget from now on. Therefore if one dollar is saved, the user's bill is six cents less per year. Every dollar spent by the city for reconstruction comes from the public and taxes will remain high until a plan is followed. A plan saves a lot of guesswork.

Importance of Zoning

The Committee believes that an essential part of this plan is comprehensive zoning—zoning which covers land use, height and area restrictions, and population density. By zoning, the load on the transportation system, sewer system, and utility system can be

very closely approximated. It gives the engineer a basis on which to design because it insures stability to the ultimate loads that will be expected. The engineer must make a plan whether there is a "City Plan" or not and zoning helps to make his estimate much closer to the ultimate development. It goes far beyond that, too. It means to the industrialist that the utilities serving his industry are going to be adequate. It means to the business man that he can locate his business in a district that is going to build up with customers and that he will not be surrounded by factories. It means to the banker that the home on which he granted a loan is going to continue to be a good risk and the money is going to be a good investment. To the home owner, it means property value insurance, as necessary as fire, flood, or windstorm insurance.

For some reason or other, cities are slow to realize the benefits to be derived from planning. In the years of insufficient revenues, 1932 to 1936, plan commission budgets were done away with in the great majority of cities, or the commissions became inactive. In nearly all cities, funds were reduced drastically. This was happening when the need for planning was greatest. State and regional planning boards were born during this period to meet the needs of emergency work and the making of jobs. Those communities which had long-range plans prepared fared well in this program. Those who had not, lost opportunities for improvement of their cities. In 1933, no more than sixty planning boards had adequate appropriations to administer their functions. By 1936, this number had slumped to fifty, even though the number of cities with planning boards increased. In that year, $1,638,000 represented the amount at the disposal of all the different planning boards. The ten largest cities accounted for $1,215,000 of this amount and the next ten for an additional $158,000 which left considerably less than one-half million dollars to be scattered among the 1,180 remaining cities having planning agencies. New planning agencies are being formed each year and yet more than three-fourths of those existing are inactive. There must have been a need for planning at one time or there never would have been any agencies formed. If the need for planning existed once, the need for carrying out that plan is still present, and that means that planning boards must be active.

That city planning boards are generally inactive and have no paid employees is further evidenced by the fact that of 204

W.P.A. projects sponsored by planning agencies, only 69 in 14 states were sponsored by city planning agencies. Nearly $8,000,000 was spent on these planning projects, which is quite a large gift to those agencies which took advantage of the offer. Agencies which had no paid employees to supervise projects naturally did not avail themselves of the opportunity for obtaining the data on which to base plans, or to start carrying out plans they already had.

The Committee also finds that in many of the cities that have master plans and zoning ordinances, many variations are made at the request of selfish interests. It appears to be impossible to resist pressure of this kind because of lack of sufficient supporting data for the plan and because of political pressure brought to bear upon public officials who have but a lackadaisical interest in the plan. Therefore, master plans and zoning ordinances must be carefully and comprehensively thought out before they are adopted and must be wisely administered by an active plan commission so that unjust variations sought by selfish interests are not perpetrated.

Recommendations

As a suggested method to improve social and economic conditions that exist in all cities and to increase the efficiency of municipal administration, this Committee recommends:

1. That all cities set up planning commissions with adequate funds to provide for at least one permanent employee on the commission.

2. That minimum funds provided for this purpose should be $2,500 and not less than 15 cents per capita for cities over 25,000 population.

3. That the planning commission be charged with the responsibility of doing the necessary research work leading up to the preparation of a master plan, said master plan to include system of thoroughfares, park and recreational facilities, public building locations and a zoning ordinance. In conjunction with the making of a plan the commission should study social, economic, and housing conditions in the community. Accompanying the plan should be a recommended program for carrying it out. The plan commission should be empowered to exercise certain measures of jurisdiction and surveillance of the carrying out of the plan.

4. That all public works officials lend their sympathetic understanding and cooperation to the work involved to the end that it may be accomplished.

Streets and Roads

GEORGE H. SANDENBURGH

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THE ADMINISTRATIVE developments which have characterized the street paving departments of our cities are quite similar to the administrative changes which have almost revolutionized all public works. The expenditure of federal funds in metropolitan areas through higher echelons of federal and state agencies has brought with its advent many new requirements of administrative staffs.

The federal government, under the "New Dealers," has accepted the responsibility of a portion of the relief problem, and in handling this problem public works have been promoted and encouraged, public money has been borrowed, and loaned and granted to the states, cities, and villages for work relief.

With these expenditures of federal funds came federal supervision in some instances, federal inspection always, and invariably a federal labor clause. Wages and hours were established for projects, the channels for the procurement of labor were established, and for all of these items and more, federal accounting systems and reports were prescribed.

Street paving, construction, design, and maintenance were deemed types of public improvements upon which federal funds might best be spent.

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* COMMITTEE ON STREET PAVING, CONSTRUCTION, DESIGN, AND MAINTENANCE, 1937

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Mr. C. A. Dykstra, President of the University of Wisconsin and former City Manager of Cincinnati, pointed out a year ago that the results of this federal policy have been far reaching indeed. He said, "Public officials find themselves urged to discover possible public projects which can be undertaken—not so much because there is public need for these improvements, but because they will put men to work. Thus the time lag between the initiation of the demand for an improvement and its final consummation has been greatly shortened. Political and financial feasibility have given way to the consideration of man-hours of work. Long accepted methods of financing are undergoing drastic changes. There was a day when local financing was accepted as a matter of course. Today federal aid in all local projects has become a matter of course. The long-honored device of special assessments is becoming inoperative to the great joy of many local property owners. . . . These new federal policies have had very direct results upon local methods of undertaking work as well. There were orthodox practices and procedures established by local laws, that is, by state and municipal ordinances, which determined the mechanics of appropriation, bond approval, bond sales methods, contract advertising, contract letting, and a host of other things. There was, also, an open field—or shall we say free trade—in materials and labor. Today the major program of local public works is governed almost entirely by federal procedure."

These federal agencies functioning with local authorities on projects of local sponsorship create a need for very close cooperation between the levels of government. The municipal street commissioner must have eligible projects available in his department, be prepared to promote them as needed, must iron out all difficulties arising perhaps with the State Highway Commission (if it is a party to a particular contract) or with the W.P.A. or sometimes to aid a contractor in complying with a P.W.A. ruling. New labor clauses in specifications must be intelligently enforced. These and other enforced contacts make it imperative that the street commissioner or other administrative officer be capable of friendly cooperation with whomsoever he must deal.

Changed Conditions Must Be Met

Administrative adjustment and flexibility of organization are necessary to cope with the changing picture.

Accounting systems must be modernized. One school of thought

believes that the benefit or tax district will no longer serve as a system for financing street paving. Some states are turning back to their cities certain proportions of the gasoline tax receipts. The cities also retain the city auto registration or city license tax receipts and sometimes these funds are augmented by property taxes earmarked for street paving purposes.

Another subtle development is taking place. Municipalities have been purchasing asphalt plants and small hand tools and equipment in larger volume, and the equipment now city owned is of a nature formerly found only in contractors' yards. The street paving department employs many men, and politicians of the "ward-heeler" type look with greedy eyes upon the control of these jobs—the more of them, of course, the better. Many economists and public works officials look with alarm upon the socialization of public works and definitely favor the more efficient contract of work to qualified low bidders. The equipment owned and operated by cities is not yet in itself alarming as forecasting a change in our system of doing work, but the "bookkeeping costs" of direct labor, city-directed work is simply marvelous—always less than contractors' prices and each succeeding city administration cuts the apparent cost—yet taxes continue to rise! The answer to this anomaly is, of course, faulty bookkeeping. Items which should have been charged to a certain project have been charged to general revenue funds. Good administration needs and relies upon honest facts, correct records, and proper accounting procedure.

The Question of Personnel

Needless to say, administrators must possess integrity and their staffs, in addition to being qualified, must have high morale. Under a certain prevalent kind of political set-up, personnel problems of a serious nature are apparent. Professor D. V. Terrell of the University of Kentucky made this statement in 1936: "Students, as far as I am able to determine, are not very keen about going into highway engineering. They take all these courses with the idea that they might have to take a job in that field. The politicians, as far as I can see, have just about taken this road business away from us. We graduate the boys and send them out. They want jobs. Perhaps they want to get a job in the highway department, but they must get it through someone with influence. This creates a bad situation."

While we are on the subject of personnel, it should not pass without note that New York passed over the Mayor's veto a bill requiring three years' residence in the city as a prerequisite to eligibility for appointment to positions in the municipal service. Politics of a low order must have motivated this bill and similar bills restricting the flow of brains into municipal service. The nation-wide and world-wide free trade in competent and qualified personnel is a crying need in local government and jobs must, if morale is to be fostered, be secure to capable men: secure beyond the reach of ward-heeler politics.

Dean Mitchell, in addressing the American Public Works Association on the "Importance of Training for Public Service," made a good point when he said, "For many years the most progressive industries of the country have kept in systematic contact with the colleges for the purpose of recruiting the most promising young people to their organizations. Should not there be the same definite and organized program for recruiting for the public service?"

All thoughtful persons must agree with Frank W. Herring, executive director of our Association, that "The key to good local government lies in competent administrative personnel."

Perhaps personnel problems should be handled for all municipal agencies by an impartial agency, but in any event the street paving department is no mean part of the city government and its director or commissioner might well have a sound personnel policy of his own.

Telling the Taxpayers

Another item in the administration of any department or agency maintained in the public interest is that of acquainting the public with what it gets in return for its tax dollars. The administration of the street paving department of a city should have a department policy which fits in with that of the mayor or city manager, and with those of other departments for impartially acquainting the public with the services rendered. Educational exhibits are not out of line. These exhibits might well include pictures of street paving, base construction, maintenance crews and designers working. Statistics are perhaps dull but some means should be found to acquaint the people with the financial, organizational, and personnel set-up of the department. Photos of new projects are items of news value,

and the local periodicals should be acquainted with the work in progress.

The administrative developments of recent years have been interesting but equally interesting will be those of the next few years. Will the contractor come into his own again? Will labor restrictions be rescinded? Will work relief continue as a policy of government on street work? Will political pressure dictate technical appointments? Will improved times see municipalities returning to benefit districts and tax assessments against abutting property for street paving or will they continue to lean on federal agencies and federal funds?

Whatever answers develop in the course of time, successful administrators of municipal street paving departments will maintain flexible but sound policies on the subjects of finance organization and personnel.

Developments in Concrete Streets

Changes in pavement design are gradual. New methods are tried in one city, prove satisfactory, and after a time are adopted by other communities. For that reason it is difficult to prepare a report describing only what is new, for what is practically unheard of in one place may have been standard practice for years in some other state. No claim is made, therefore, that the details of concrete pavement design, construction, and maintenance described here are entirely new, but only that they are the more recent developments.

As an illustration of practice that embraces the latest research and experience in concrete pavements there can be cited the methods used in Washington, D. C., as described by H. F. Klemmer, Engineer of Materials, in *Engineering News-Record*, November 19, 1936. The main points stressed in this article are quoted as follows:

All concrete pavements less than 40 feet wide have a 20-foot center section with a thickened edge and a center longitudinal contraction joint, side sections are tied to the middle sections with a ½ inch diameter bar 3 feet long spaced 5 feet apart. The edge of the side section adjacent to the center section is thickened to equal that of the center slab. Gutter and curb are constructed integrally to eliminate the need for thickening the outside edge.

Bituminous impregnated paper is used to cover all subgrades before placing concrete. The use of this covering, which is negligible in cost,

has proved of value in controlling the consistency of concrete and permits the use of a much drier mix. Variation in the absorptive characteristics of different types of subgrades causes definite variation in the consistency of the concrete unless the subgrade is covered with moisture-proof material.

Mesh reenforced steel weighing 50 lb. per 100 square feet is used in the construction of all concrete pavements. Expansion joints of the metal air cushion type using either dowel bars or the formed keyway for transfer of load are installed at 40 feet intervals when concrete is placed at temperatures of 55° F. or below. When the temperature at the time of construction is over 55° F. expansion joints are placed at intervals of 60 feet with contraction joints at midpoints, using the same design for the transfer of load and for sealing the surface as for expansion joints. Expansion joints are ½ inch wide rather than the usual 1 inch to effect more efficient load transfer. Where dowel bars are used they are spaced 12 inches apart.

Specifications for the protection and curing of concrete require covering with layers of saturated burlap or the surface application of calcium chloride.

THICKNESS

Thickness is probably the most important design detail for concrete pavement. It has been affected recently by two developments: (1) a method of design which takes volume of traffic into account as well as the weight of loads that are using the pavement; and (2) a gradual increase in the strength of cement, so that concrete going into pavements in 1936 had about twice the strength of concrete of the same cement factor and consistency in 1918.

A method of design which took volume as well as weight of traffic into account was developed by Frank T. Sheets in 1933. Prior to that, formulas considered only the weights of trucks, although highway engineers realized that pavements carrying many trucks were subjected to more severe punishment than those carrying only a few.

This new design method makes it possible to calculate with satisfactory accuracy the required thickness for concrete pavements on all classes of thoroughfares; on through streets carrying many hundred vehicles daily; on streets in the main business section or leading to docks and freight stations; and on a dead-end street carrying the traffic of only a dozen residences.

When uniform thickness slabs are considered, for concrete of 700 lbs. per sq. in. modulus of rupture, thicknesses range from

8¾ inches, capable of carrying an unlimited number of 14,000 lb. wheel loads (a gross load of about 21 tons on a 4-wheel vehicle) down to a 5½-inch pavement for a residential street on which not more than about 3 trucks carrying a gross load of 12 tons on 4 wheels (a wheel load of 8,000 lbs.) are anticipated per week.

For many years city engineers have been fitting the thickness of concrete pavement to the anticipated traffic, building heavy slabs on heavy traffic streets and thinner sections where traffic was sure to be light. The new design method permits still further refinement in fitting the slab to the load and allows the engineer to base his design on calculation as well as experience.

Thickened-edge sections can be used for street pavement with the same economy as for highways. If a thickened-edge section is adopted, in which the change from edge to interior thickness is attained in 2 feet, the thickness of the interior of the slab will be 85 per cent of that of a uniform thickness slab that will carry the same load, while the edge thickness will be 127.5 per cent that of the uniform thickness slab.

The thickened edge is used wherever wheel loads can run along an unsupported edge. By "unsupported" is meant an edge which is not aided by an abutting slab in the carrying of loads. The edge of a pavement bordering a streetcar track area should therefore be thickened, as well as that along any longitudinal joints which are not of a keyed type and held together by tie bars. The outside edge of the slab along a gutter area should be thickened unless this part of the pavement is so given over to parking that regular traffic never reaches the edge of the slab. The slab edge along a straight curb is not thickened because wheels cannot run along it.

Formulas for slab thickness include an expression for concrete strength. During the period in which concrete pavements have been popular, beginning about 1918, the strength of cement and correspondingly the compressive strength of concrete have materially increased. In 1918 a paving mix containing about six sacks of cement per cu. yd. had a compressive strength of around 3,000 lb. per sq. in. Today the same proportions of aggregate, water, and cement produce a concrete having a strength of around 5,000 lbs. per sq. in. With these high strengths, slab thicknesses need not be so great as was required for the same load when 1918 concretes were used.

JOINTS

Recent developments indicate increasing attention to the importance of expansion joints. Standard practice today calls for the installation of expansion joints at fairly long spacing with simple and less expensive contraction joints intervening at shorter intervals. Control of cracking is accomplished at a cost much less than where expansion joints alone are used. Several types of non-extruding expansion joint fillers have been developed recently and the practicability of installing these joints in concrete bases has been demonstrated. A number of new load transfer devices for the strengthening of slab ends have been offered to the trade and there have been other developments in the design and use of older types. The use of dowel holders or complete dowel assemblies which are placed as a unit in the pavement is increasing. The City of Pittsburgh has adopted the cork-board expansion joint material for all transverse expansion joints in blockstone surfacing, vitrified brick surface with grouted joints, and plain or reenforced concrete street pavements.

Transverse Joints. Since the spring of 1934 when the U. S. Bureau of Public Roads ruled that all concrete pavement built with federal aid must have expansion joints spaced not farther than 100 feet apart, contraction joints in plain concrete pavement be not farther than 30 feet apart, and that all transverse joints be dowelled, joints have been the most discussed feature of concrete pavement.

The Bureau also required that the expansion space be not wider than 1 inch nor narrower than ¾ inch. The only function of expansion space is to reduce expansion stresses which might otherwise cause blow-ups, spalling, or longitudinal cracking.

Surveys of a large mileage of concrete pavement indicate that an expansion space of ¾ inch for each 100 feet of pavement is ample to protect the slab from blow-ups. In Pennsylvania an average expansion space of only $^3\!/_{10}$ inch per 100 feet of slab held the blow-ups to only about one in 100 miles. Very wide expansion joints are generally frowned on because with them the impact from truck wheels crossing the joint is greatly increased. Experience indicates that the joint width should be limited to about 1½ inch.

Many city engineers place expansion joints around intersections only, while others space them at intervals of 60 to 150 feet.

Transverse cracking is controlled by contraction joints spaced at

intervals of 20 to 25 feet between expansion joints. These may be of the dummy type which is a groove in the surface to one-fourth the depth of the slab, or a deformed metal plate, like that commonly used for longitudinal joints.

Joint Fillers. Considerable attention has recently been paid to the improvement of joint fillers. The common bituminous filler, whether of the poured or premolded type, has at least two faults. When the joint closes, bitumen extrudes and forms a bump on the pavement. When the concrete contracts with cool weather or drying, and the joint opens, the bitumen does not expand to fill the space that is left and the joint is open to the entrance of soil or water. The soil usually gets into the joint at the end because it is carried there by the gutter or worked in from the shoulder if the pavement has no curb and gutter, and then when the joint closes, the expansion stresses are concentrated at the end of the joint so that the concrete fails or a diagonal crack forms on the end of the joint running into the concrete slab. If water gets into the joint it softens the subgrade and greatly reduces the bearing power under the joint so that heavy loads have a chance to break the slab. Or if the soil is of an expansive character the water seeping into it may make it expand enough to actually lift the slab. For these reasons the ordinary bituminous fillers have fallen somewhat into disfavor in highway work but are still almost universally used for streets, because on streets the subgrade is usually of a better grade and there is not a great chance for infiltration.

Many new types of filler have recently been suggested for use in expansion joints. Among these are cork-board, premolded rubber, wood and cane fibre, several varieties of joints with metal sides and flexible copper caps, sawdust, cotton-seed hulls, and combinations of cork and rubber or cork and bitumen. Ordinary boards have also been successfully used.

The ideal joint filler would be inexpensive, would not extrude, would keep the joint space filled so that water or solid matter could not enter, and would have a life equal to the life of the pavement.

Careful inspection of nearly all the installations of these newer fillers indicates that most of them eliminate objectionable extrusion but that none of them are of themselves water-tight at all times of the year. Many are water and soil-tight during the summer

months, when the concrete is expanded, but during cool weather the joints open sufficiently to permit infiltration. Joints which were continuously proof against infiltration were found only where they were covered with a seal which was sticky enough to adhere to the concrete and soft enough to keep the joint filled as it opened and closed. With such a seal the cheaper joint fillers, such as cotton-seed hulls, sawdust, boards, and fibre, were as satisfactory as the more expensive ones.

No completely satisfactory seal has yet been developed. Combinations of rubber and bitumen and of bitumen and diatomaceous earth seem to hold the most promise. Rubber latex has been tried but is comparatively expensive. When the seal is supported firmly from below, a much softer seal can be used than has been common in the past for filling cracks and joints.

DOWELS

When the thickened-edge design is used or, for uniform thickness sections, when transverse joints form the only free edges along which wheels may run, these edges at joints will be the weakest point in the slab unless some method of strengthening them is devised.

One method of strengthening is to thicken the edges, the same as the outer edges of slab. Experience with such edge thickening has not been universally satisfactory. In both Georgia and Missouri this design was used at joints placed several hundred feet apart. Something like 12 per cent of these thickened-edge joints developed one or two transverse cracks within four feet of the joint, apparently because the thickened edge provided anchorage which kept the slab from sliding freely over the subgrade. But on streets in New Orleans and in Grays Lake, Illinois, as well as extensive highway work in Kent County, Michigan, where joints were spaced only 40 or 50 feet apart, slabs thickened at the joint have proved extremely satisfactory. Such a cross-section introduces some subgrading difficulties, unless the mixer is kept outside the forms. At present, subgrading for the thickened slab ends is done by hand, although a machine could easily be developed for it.

The alternative is to install some device for transmitting load from one slab end to the next. Smooth, round dowels ¾-inch in diameter, 2 feet long, and spaced 12 to 15 inches apart are most commonly used. These have not proved entirely satisfactory under

extremely heavy traffic, and other load transmission devices have sometimes been used.

New Jersey uses small channels instead of round dowels. The greater stiffness of this channel, and the greater bearing on the concrete, as compared with the round dowel, make the channel considerably more efficient in transmitting loads.

New York State is using a device which is anchored in one slab end and extends underneath the toe of the abutting slab. It has been in use about three years and so far has proved satisfactory under very heavy traffic.

Still another device, similar to the one used by New York State, is manufactured by a company supplying various steel devices for road purposes, and has been adopted by at least two states and used extensively in others. It also has so far been successful under very heavy traffic.

These devices providing support for the toe of the abutting slab have an advantage which dowels lack; namely, they permit the cleaning of the joint from top to bottom. Ordinary dowels, and all other types of load supporting devices which extend across the joint at about its mid-depth, complicate thorough joint cleaning.

Another load transmission device has cast-iron sockets in the slab ends enclosing a machined steel pin which acts as a dowel. Tests by the U. S. Bureau of Public Roads indicate that it has satisfactory load transmitting properties.

RESURFACING

Each year sees the increased use of concrete for resurfacing old concrete bases or old pavement. Many cities have found this a satisfactory and economical method of strengthening and improving the riding qualities of pavements which have worn out or have proved too weak to carry the heavy loads imposed by today's traffic. More than 2,000 miles of this type of work have already been done on the roads and streets of the United States.

In Seattle, for example, many streets, especially in the business district, have been resurfaced with concrete. The old brick, asphalt, or wood-block surface is removed, sometimes by a steam shovel; the concrete base is cleaned, and a new surface 5 or 6 inches thick is put on. Joints are put in as for pavement on ordinary subgrade. Nothing is done either to obtain or prevent bond between new and old concrete.

CONSTRUCTION

Subgrade Preparation. The most casual observation will convince anyone that subgrade settlement is the most common cause of pavement breakage. The old methods of compaction, with an ordinary roller, have not prevented this damage. Saturation of the deeper fills by jetting has been advantageous on many types of soil, but has not been universally satisfactory.

So a new technique has been developed for consolidating fills. It is generally known as the Proctor method and has been extensively used on highway work and in the construction of earth dams. It has been found that if soil containing just the right amount of moisture is thoroughly compacted from top to bottom, as is possible with a sheep's-foot roller, a condition of optimum density will result, the soil will not absorb nor lose appreciable moisture, and will neither shrink nor expand.

Use of the Proctor method of compaction requires laboratory control but this control is comparatively simple and inexpensive and the resulting freedom from settlement breakage is well worth all that it costs.

One of the most frequent causes of pavement breakage in cities is the settlement of trenches. This could be entirely avoided by applying Proctor control when these trenches are filled, adding just the right amount of water to the dirt and substituting the mechanical tamper for the sheep's-foot roller.

There has also recently been put upon the market a machine which will bore a 4- to 6-inch diameter hole horizontally through earth for a distance of 80 to 100 feet. If such a machine were required for the installation of all small pipes in city streets much of the damage now done by settling trenches would be eliminated.

A subgrade machine has been recently developed, making it possible to cut a cross-section of any required shape from a rough grade which was intentionally left high. It is claimed that rough grading need not be so accurately done because the fine grading is more easily and accurately completed by this machine than was heretofore possible.

MIXING

Some old tests indicated that concrete strengths increased with increasing mixing time up to about 5 minutes. More recent tests by many agencies indicate no appreciable increase in either strength

or uniformity of paving concrete for mixing times greater than 45 seconds. Most specifications recognize this by specifying a 1-minute mixing time, allowing 15 seconds for errors in timing and the possibility of defective equipment. Mixing times longer than 1 minute are a waste of money and should be abandoned while a 45- or 50-second mixing time could safely be used with good inspection.

The dual-drum mixer, in which the batch is partly mixed in one drum then shifted to a second drum in which mixing is completed, cuts the mixing cycle per batch to about 40 seconds as compared with 67 to 70 seconds for the modern single drum paver, when the total mixing time is 1 minute. A dual-drum thus greatly increases production without a proportionate increase in labor and equipment. Such a paver should, therefore, reduce pavement costs, but for this reduction to be realized the entire paving outfit must be geared to the faster speed of the mixer, which requires intelligent and efficient superintendence.

Another change which increases production is use of the largest batch that can be handled by the mixer. Following adoption of the 27E as the standard size paver, mixer manufacturers generally improved their mixers and increased engine capacity until the present 27E can handle a 32 cu. ft. batch as efficiently as 27 cu. ft., unless grades exceed about 6 per cent.

Proportioning by weight is now almost universal practice. There is, however, considerable variation in the method of determining proportions. Many cities and states now use fixed proportions of one type or another. Others design mixtures by the water cement ratio, void cement ratio, or by absolute volume methods. The method that gives the weight of material to be used per sack of cement for various specific gravities of the aggregate seems to be gaining in favor. The method that fixes the absolute volume of mixed aggregate per absolute volume of cement probably has the greatest number of advantages of any of the fixed proportions.

PLACING CONCRETE AND FINISHING THE SURFACE

There is a growing sentiment for placing concrete pavement with the mixer outside the lanes being paved. Such an arrangement permits the placing of joints well in advance of concreting and eliminates hauling over the subgrade. City streets are usually wide enough to allow this method of construction.

The finishing machine, long required on all highway work, is being adopted for city pavement construction. It is commonly used only on those lanes that will accommodate moving vehicles, while a 6- to 8-foot parking lane and monolithic curb are finished by hand after traffic lanes are completed. In this way street pavements are given riding surfaces equal to those of country roads.

A machine designed to improve the riding qualities of the concrete pavement is the power-operated longitudinal float. The 10-foot longitudinal float or screed is supported by a wheeled framework which rides the forms. The screed moves across the slab with a combined longitudinal and transverse movement. It is so supported that it conforms to the desired shape of the crown of the pavement and irons out longitudinal irregularities.

Vibration is the most recent addition to placing and finishing equipment for pavements. It still must be considered in the experimental stage as no wholly satisfactory vibrator has yet been put on the market.

There are four general types of vibrators. In one the screed is vibrated as the pavement is struck off. The vibrator may be mounted either on a hand screed or on the front screed of the ordinary finishing machine.

A second type has a vibrating pan mounted between the front and rear screed. This will not handle as dry concrete as the one having the vibrator on the screed itself.

Another machine has a vibrating rod buried in the concrete ahead of the first screed of the ordinary finishing machine, the vibratory effect being great enough to allow striking off of concrete of about 1-inch slump and to thoroughly consolidate the concrete and eliminate air and water voids.

Still another type abandons the conventional finishing machine entirely and consists of a trough into which the concrete is dumped from the mixer. In one, a vibrating rod is placed horizontally at the throat of the trough and at about the level of the pavement surface. This vibrating rod causes the concrete to flow smoothly under the back edge of the trough, which strikes it off at the proper elevation. Other models have a vibrating pan or diaphragm at the back edge of the trough. These trough vibrators are not yet on the market but seem to hold considerable promise as they will handle very dry concrete. Some mechanical difficulties have yet to be overcome before they will be ready for general use.

The advantages of vibration are the reduction in costs of the concrete and production of a concrete having less air and water voids. Reduction in cost is realized because a much drier concrete can be used and, therefore, the cement factor can be reduced without increasing the water-cement ratio. In experimental work some of these machines have produced with 4 sacks of cement per cu. yd. a concrete as strong as that ordinarily secured with 6 sacks.

The disadvantages of vibration are the danger of excessive laitance or mortar being brought to the surface, with resultant scaling, the tendency of concrete to well up behind the vibrating medium to make a rough riding pavement, the difficulty of keeping forms in grade and alignment when heavy vibrators operate over them, and the tendency of the vibrators to shake apart the machines on which they operate.

CURING

Tests conducted by the U. S. Bureau of Public Roads, using wetted cotton mats, indicate that this is an excellent curing material effectively retaining moisture which the concrete requires, and protecting it from both high and low temperature extremes during the early hardening period. The use of reenforced waterproof paper for curing is also increasing in popularity.

Not so many years ago specifications generally required from 14 to 21 days of curing and perhaps 28 days before a pavement could be opened to traffic. Today 3 days' curing is common and, during warm weather, pavements are frequently opened to traffic in from 5 to 7 days.

The shorter curing period has been brought about by field tests which indicate that pavements cured only 3 days have substantially the same strength as those cured for 14 days or longer. Concrete cured in the open air obtains moisture from rain and dew and these apparently make its strength greater than that of concrete cured for the same short period in the laboratory. A short curing period is of particular interest to city engineers because it makes economical the use of burlap or cotton mats as the curing medium instead of some material like earth or straw which may be washed into storm sewers. The burlap or cotton mats also leave the pavements cleaner looking than earth or straw.

An impervious paper, spread over the surface of the concrete

immediately following final finishing, prevents evaporation and also seems to give satisfactory results as a curing agent.

Early opening of concrete paved streets is distinctly an advantage to business men and can be safely done if beams are made at the time the concrete pavement is laid, cured the same way as the pavement, and are broken to determine when the pavement is strong enough to carry traffic. A beam strength of 500 to 600 pounds is generally considered sufficient to warrant opening of the pavement. Satisfactory portable beam testing machines can be purchased at prices from about $200 up. A machine providing for loading the beam at the third points is preferred because it permits correlation of field tests with those of the laboratory, where the third point loading is now standard.

The City of Pittsburgh specifications allow the contractor the option of curing concrete by the use of "bituminous curing compound" or a "colorless transparent film" in accordance with the following specifications:

> Bituminous curing compound may be used only for curing concrete pavement bases where bituminous cushion and bituminous surfacing is to be applied, and for curing concrete roadway pavements provided care is exercised to prevent the compound from contracting curbing of all types, including concrete, and the areas on which deck curbs are to be constructed. The colorless transparent film may be used for curing all concrete except concrete pavement bases on which a cement sand cushion is to be applied or concrete to which future concrete is to be bonded.

MAINTENANCE

Maintenance of concrete pavement consists of cleaning joints and refilling them, and replacing pavement removed to get at underground service pipes.

With ordinary fillers, soil gets into expansion joints and should be removed if damage to the pavement is to be avoided. It is worse than useless to fill the top half-inch of a joint, leaving sand or soil below. Crowfoot and longitudinal cracks are caused by such slip-shod maintenance. The joint should be cleaned to its full depth before it is filled.

The most effective and efficient method of cleaning joints is to plow out the bituminous material and earth with a specially designed tool just wide enough to go into the joint, pulled by a cable from the drum of a small tractor. Joints can be cleaned and

refilled in this manner for about 2½ cents per foot. The work need be done only every two or three years.

Too many maintenance departments find the job of cleaning joints too arduous and content themselves with spreading bituminous filler over the surface of the pavement near the joint, where it does no good and is extremely unsightly.

It is easy to put in patches that are not distinguishable from the balance of the pavement. This is done by preventing shrinkage of the concrete in the patch. Edges of the opening are trimmed so they are reasonably vertical. A very dry concrete is prepared, of about the same proportions as the balance of the pavement. This is thoroughly tamped into the hole and allowed to stand for about 45 minutes, when it is retamped. Most of the shrinkage will have occurred during the 45 minute standing period and no tell-tale crack will form between new and old concrete. The patch is finished to conform with the balance of the pavement.

ICE REMOVAL

Some maintenance departments remove ice from concrete pavement with salt or calcium chloride. Others mix one of these chemicals with gritty material to be cast on the ice to reduce slipperiness. Either practice may cause scale that will seriously damage the pavement, especially if the pavement is only two or three years old. Some other method of reducing slipperiness should be resorted to, such as the use of hot sand instead of the chemically treated sand.

If chemicals are used, the pavement should be protected from damage by the application of two coats of "boiled" linseed oil. The oil is thinned with benzine, gasoline, or naphtha and applied with a brush, a spray, or a pressure distributor. The first application is at the rate of about 1 gallon for 50 sq. yd. and the second, put on after the first has "dried in," at the rate of about 65 to 70 sq. yd. per gallon. These two applications will protect the pavement throughout its life. The cost is from 3 to 5 cents per sq. yd.

Caution: The oil mixture is highly inflammable and in the form of spray would burn with explosive rapidity. It must be carefully guarded from fire. The second coating usually makes the pavement temporarily slippery so that traffic must be excluded for a few hours or the pavement sanded to avoid accidents.

Developments in Brick Pavements

The brick pavement structure consists essentially of the following component parts:

1. The Surface Course. Composed of rectangular-shaped vitrified clay units assembled in regular pattern with the joints or interstices completely filled and sealed, binding the units together.

2. The Bed or cushion course. A thin layer of granular material on which the paving brick units are laid and imbedded and which will permit slight adjustments because of irregularities in the foundation or permissible variations in the depths of the brick.

3. The Base Course or foundation. Supports the bed and surface and distributes traffic loads to the subgrade.

PAVING BRICK UNIT

Anti-Skid. The character of present-day high speed motor traffic and recognition of the fact that highway plans in the future will provide for even greater speeds have created the demand that the wearing surface of the modern paving brick unit be anti-skid in character. Paving brick are formed by what is known as the "Stiff-mud" process of clay products manufacture. The shale or clay, after being ground very fine, is thoroughly mixed with water to the proper consistency. A powerful auger then forces the stiff mixture through a die onto a moving belt in the form of a column. This column is carried to the cutter where taut wires automatically cut it into brick units. In so-called vertical fiber paving brick the width and length are determined by the dimensions of the die and the depth by the spacing of the wires on the cutter. In the wire-cut-lug type the depth is the shorter dimension of the die and the lugs are formed by an eccentric motion given to the cutting wires. In this type the smooth or die side of the brick is in the surface of the pavement. When the brick are repressed before burning, the surface is also smooth.

Formerly the repressed and the wire-cut-lug types were in general use and preference for them was in a large degree based on their having the side lugs considered essential for the proper filling and sealing of the joints. However, the manufacture of brick having a wire-cut wearing surface with lugs on the side and ends is now commercially practical and this type, known as vertical fiber lug, is now the most popular single variety in use in the

United States. Regardless of the type of vitrified paving unit that may result from future developments, it will undoubtedly have a roughened or deformed wearing surface of non-skid character.

Standard Types and Sizes. Since 1921 the Division of Simplified Practice of the U. S. Bureau of Standards, through a committee composed of representatives of engineering and technical societies, has annually recommended a standard list of sizes and varieties of paving brick.

Following is the current recognized list:

Variety	Depth	Width	Length	1936 Shipments (Per cent)
Repressed Lug	4″	× 3½″	× 8½″	7.1
Vertical Fiber Lug	2½″	× 4″	× 8½″	12.8
Vertical Fiber Lug	3″	× 4″	× 8½″	51.3
Vertical Fiber Lug	3½″	× 4″	× 8½″	9.3
Total of 4 Varieties Recognized				80.5

It will be noted that the list does not contain any lugless varieties which at one time were in general use in the western part of the United States. The proportion of vertical fiber lug brick shipped in 1936 (73.4 per cent) is the greatest for any type since standardization was initiated.

Specifications. Practically all standard specifications for the physical qualities of paving brick used by specifying authorities are identical with or in essential details are based on those of the American Society for Testing Materials. The requirements in regard to the abrasive loss in the rattler test are sometimes varied (usually downward) to apply to the quality of brick available in a particular locality. The standard specifications for paving brick of the A.S.T.M. had not been revised since 1929 until this year (1937) when new "Tentative" specifications were adopted and the old standard withdrawn. The most notable innovation is the additional requirement to the rattler test, limiting the number of broken pieces weighing one pound or more. Some specifications, notably those of the Highway Department of the State of Ohio which is a large user of paving brick, had in recent years added a test for flexural strength. An investigation indicated that there was close coordination between broken brick in the rattler and

low flexural strength. It is believed that a broken brick requirement will be more determinate than the flexural test in that it will detect brick that have minute cracks on only one surface. In addition it is considered a criterion of toughness. This is the first time that the rattler test which was devised in the United States has been modified, although it is realized that its application by stages is a part of testing practice used in Holland.

De-Aired Brick. Most paving brick plants are equipped with machinery for evacuating the air from the mixed clay or shale during the process of manufacture. De-airing with proper methods will produce a brick of greater strength and density and improved regularity of shape. Glassy structure causing brittleness must be guarded against and accurate control in manufacture is necessary in order to obtain the full advantages of the process. The Research Bureau of the National Paving Brick Association at the Ohio State University Experiment Station at Columbus, Ohio, has made observations on the internal structure of paving brick manufactured with various degrees of vacuum and methods of forming, with a view to further perfecting plant practices. In some cases authorities have specified that the paving brick be "de-aired," although usually, as in the A.S.T.M. standard, the physical requirements govern with no mention of the method of manufacture. In the brick to be used for paving the first tube of the new Lincoln Tunnel under the Hudson River in New York City, a maximum of 18 per cent rattler loss for $3 \times 4 \times 8\frac{1}{2}$ inch de-aired brick is the requirement.

CONSTRUCTION AND DESIGN

While the type and quality of the paving brick unit is a matter of fundamental importance, its method of utilization is at least of equal moment. Brick in the pavement are surrounded and supported by a number of other materials of construction. The excellence of the pavement structure as a whole is the objective of design and construction requirements. Most of the researches and developments concern improvements in what may be termed auxiliary materials and the manner in which they are used.

Bed Course. The bituminous sand mastic bed is increasing in favor although untreated sand, stone screenings, granulated blast furnace slag and sand-cement are also used. Mastic material has the advantages of being waterproof and stable and of having considerable ability to bridge over cracks in the base. The problem

is to obtain a mixture that will contain ample bitumen content, that can be prepared without expensive plant equipment, and that can be readily handled and shaped. The specifications for mastic bed of the American Public Works Association are typical of those in most general use, the bituminous material being a cutback asphalt or tar. When it is considered desirable to have greater stability, a mastic that has an ultimate bitumen content of about 10 per cent can be obtained by using powdered asphalt with a suitable flux. A more recent development that is reported to have had considerable success provides for the incorporation of a greater bitumen content by the use of a liquefying agent with an asphaltic cement. Sand-cement, granulated slag, and stone screenings, all of which are cementitious in character, show indications of not being as satisfactory with a flexible filler as untreated sand.

In the early practice the bedding course or cushion varied in thickness to take care of irregularities because of the rough finish of the base. This frequently resulted in shifting of the cushion, with consequent effect on the brick surface. Present design has a much thinner bed with a uniform thickness of not greater than ¾ inch, which is possible because of a correspondingly smooth base course surface requirement.

Fillers. The surface removal method of bituminous filler application introduced several years ago has now become practically universal practice. The requirements for this method as at present practiced are covered in the American Public Works Association Brick Pavement Specifications.

Investigations by Messrs. Stinson and Roberts, reported to the Highway Research Board in 1933 and 1934, indicated that the coefficient of friction, both rolling and sliding, on "a vertical fiber brick road, free of asphalt filler" was practically the highest of any of the types included on their tests. Observations made by them on the same pavement during the second and third years after completion indicated a measurable reduction in friction. According to their report, this was because the asphalt progressively extruded from the joints in hot weather and covered a considerable percentage of the surface. This is also considered a contributing factor to the trouble experienced in some cases on high-speed trafficked pavements of filler coming out of the joints.

A prominent part of the work of the Research Bureau of the

National Paving Brick Association has been concerned with the development of paving brick joint fillers that are non-extruding in hot weather. Consideration has been given to cement grouts, bituminized cement grouts, plasticized sulphurs, and bituminous fillers. Among the bituminous fillers, comparisons have been made between asphalts from different base crudes, asphalts of different softening points and penetrations, asphalt mastics and straight pitches and pitch mastics. In the laboratory the properties and behaviors of the fillers were observed and interpreted in terms of practicability. Special emphasis was given to a test wherein the extruding or receding tendencies of the bituminous fillers were observed by subjecting filled brick panels (of about one square yard area) to prolonged periods of simulated summer temperatures. From these tests a number of fillers were selected as worthy of actual pavement trial.

In cooperation with the Ohio Department of Highways and the U. S. Bureau of Public Roads, a project was planned and completed (November 1935) in which the entire length of one and one-quarter miles of new brick pavement in Ohio Route 31 in Hocking County was allotted to a test of fillers. Of these fillers thirteen are in sections exceeding 300 feet in length and eight in sections somewhat shorter. During construction, observations were made to determine the practicability of application, including the surface removal of the fillers. Since completion of the pavement, thorough inspections of the fillers under service have been made periodically. While this pavement has been in service but a little more than two years, the weather experienced has been exceptionally severe. During the winters, maintained periods of sub-zero weather were undergone. The summers, being of exceptional warmth, were featured by periods during which temperatures exceeded 100°F.

The Ohio Highway Department, basing its selection on satisfactory behavior in the test road to date, has designated four of the fillers for more extended use and further trial in brick pavement projects. In 1937 these four fillers were optional requirements on twelve projects. They can be described in general terms as follows:

1. A "blended" asphalt, being 65 per cent mid-continent base and 35 per cent asphaltic base; penetration at 25°C. of 23 to 32; softening point 101-110°C.

2. A blended asphalt very similar to the above, with 20 to 30

per cent finely divided mineral content; penetration at 25°C. of 17 to 26; softening point 107-116°C.

3. A special coal tar pitch; penetration at 25°C. of 35 to 65; softening point 60-75°C.

4. A plasticized sulphur-asphalt mixture with sulphur content 38 to 42 per cent; penetration at 25°C. of 28-34; softening point 65-75°C.

In the surface removal method of filler application, penetration of the separating agent into the vertical joints is undesirable and is prohibited by standard specifications. The prevention of leakage requires rigid field control, and the Research Bureau of the National Paving Brick Association is now engaged in developing application methods which will make the required results more certain. With the removal of the excess mat on top, a more thorough inspection of the pavement is possible. One consequence has been the requiring of end lugs instead of beveled ends (bulged). These lugs on each end are non-meshing so as to provide for free flow of filler and function equally well when the brick are turned.

Attention is also called to an improved pitch block filler that has been recently developed. It is claimed that the improved pitch does not flow readily in hot weather and still is not excessively brittle in cold weather. Also that this filler retains the adhesiveness and waterproofing qualities of the older types of pitch used with the additional advantages mentioned. The specifications for this improved pitch block filler are as follows:

> The filler shall be a coal tar pitch conforming to the following requirements:

Softening Point, ring and ball, deg. C.......	60 to 75
Penetration, 0° C., 200 grams, 60 sec.	Not less than 12
Penetration, 25° C., 100 grams, 5 sec.	35 to 65
Penetration, 46.1° C., 50 grams, 5 sec.	Not more than 200
Insoluble in Carbon Disulphide, per cent ...	Not less than 20
Specific Gravity 25° C/25° C.	Not less than 1.18

Base Courses. The requirements for foundations or base courses will vary according to local conditions of climate, subsoil, and traffic loads. In the southern section of the country, vitrified brick surface courses are successfully used on such foundations as natural sand, gravel, crushed stone, slag, shell, and Florida lime rock.

Brick pavements have, of course, given excellent service on macadam, black base, and concrete.

Concrete is the material commonly used as a foundation course for city streets and heavy traffic pavements. With proper subgrade conditions most engineers, particularly for city pavements, prefer a relatively lean concrete for the base. It will be less affected by temperature changes and, because of lower tensile strength, cracks that form are smaller and more dispersed, have greater resistance to displacement, and are less likely to affect the surface. Reinforcing with steel mesh or bar mats, usually in lieu of a richer concrete, is an increasing practice. Expansion joints in base course are the cause of disturbance of the brick surface and are advised against. With plain concrete, transverse weakened plane or construction joints are used to a considerable extent. A center longitudinal joint with dowels at lane intervals similar to that in concrete pavements should be used. With integral curbs, which perform the same functions, thickened edges are not required.

In connection with a discussion of joints in concrete bases it would be apropos to mention that the monolithic type of brick pavement shows some signs of revival. In this design the brick without cushion are laid directly on the green concrete base and filled with cement grout. On an experimental brick road on Ohio Route 43 in Carroll County, constructed in 1933, a section of monolithic was included. The construction included a longitudinal center joint and 1-inch transverse expansion joints at intervals varying from 50 to 100 feet. A smooth surface was secured and the section is now in perfect condition. Further projects of this design are contemplated. It would seem certain, however, that if the monolithic type should again receive favor, the present standard brick pavement with cushion and flexible filler, which has proved its merits, will continue to be the preferred type for general use, particularly for municipal streets and for resurfacing.

Longitudinal Laying. In December 1936 the Ohio Highway Department completed with federal aid the construction of a section of brick pavement on Route 31, located a short distance from the filler test road previously mentioned, in which the brick were laid longitudinally; that is, with the 8½-inch dimension parallel with the curbs. Longitudinal laying was not a complete innovation as it had been used previously, notably for car track areas, parking strips, on grades, and to a limited extent in normal installations.

However, this project was the first of its kind using modern construction methods. Contemplated advantages included smoother riding, reduction in traffic noise, spanning of base cracks lengthwise, a reduction in breaking of brick for transverse closures, economy in labor of laying because of unlimited length of rows, and the elimination of special wedge-shaped sections on curves. The project completed in 1936 was 1.35 miles long, 20 feet wide over-all, 3-inch fiber lug brick on a concrete base, with 9-inch integral curbs, using standard asphalt filler. An extension of this project for 1.5 miles using non-extruding filler is now (September 1937) under construction. The specifications for the first project did not permit "batting" but it was necessary at infrequent intervals to cut brick at transition points. Also because brick were respaced or shifted on the cushion, the resulting surface contour was not so smooth as expected. Quoting from the specifications for the second project, "Where the width of the longitudinal courses of brick is such that the entire width between curbs is not covered, transverse batting will be permitted at one curb. In no case will bats shorter than one-half (½) brick be permitted." It is believed that the appearance of the pavement will not be noticeably affected because of permissible batting at one curb, and economy in laying and a smoother surface will result.

Continuous longitudinal joints would be an evident disadvantage if traffic is predominantly of the steel-tired type. However, this type of traffic is practically non-existent today. The future performance in service of these projects will determine whether the apparent advantages of longitudinal laying in some respects has sufficient practical value to justify a change in present practice.

Relaying. While it would be no exaggeration to say that many hundreds of brick pavements twenty-five years or more old have been relaid in the last decade, this type of reconditioning attained unprecedented proportions in the federal program of work relief. Engineers who have decided to salvage and relay the brick—either utilizing the old base or on a new foundation—have obtained very satisfactory results. Care and skill used in the reconstruction will produce a structure that approaches a new brick pavement in appearance and characteristics. Brick pavements over forty years old were "turned over" in Marion, Ind., Montgomery, Ala., Washington, Pa., Toledo, Lancaster, and Defiance, Ohio, and Chicago, Illinois.

As the removing and cleaning of the old brick before relaying is entirely a labor item, the cost will vary with the wages paid. The cost of cleaning is also dependent upon the type of filler used in the original construction. The extreme conditions would be represented by sand filler and a rich cement grout filler. Because of the factors mentioned, the cost among different projects has varied from $1 to $12 per thousand of brick. In most of the old brick pavements the bricks were laid on edge. When relaid they are frequently laid flatwise, according to present-day practice, and there is a gain in surface area. This fact affects the percentage of salvage measured by the area covered by the relaid brick. In some cases this has actually resulted in a salvage greater than 100 per cent and a surplus of brick which were used for additional paving. However, the average proportion of salvaged brick is about 80 per cent. Owing to the increase in manufacturing costs since the brick pavements were originally constructed years ago, the relay value of the brick is in many cases materially greater than the original cost.

In the relief program, reclaiming and relaying old paving brick are providing ideal useful relief work and incidentally exemplify the salvage value of this type of pavement.

Reinforced Brick Pavement. Reinforced brick masonry in which steel rods are imbedded in the mortar joints has been used to a considerable extent in recent years in building construction. This is particularly true in California where it is considered desirable because of earthquake conditions. In June 1931 a reinforced brick pavement slab was installed in the driveway entrance to the plant of a paving brick company in Illinois. Brick were placed in a "basket weave" manner with three brick constituting a unit. Reinforcement of ⅜-inch round deformed bars was placed at 8-¾-inch centers both ways, 1 inch from the bottom, and all joints filled with 1:2 cement mortar. Two weeks after the slab was completed an excavation was made under one side, creating a clear span of five feet. It is estimated that during the past six years 25,000,000 paving brick have been trucked over the pavement which shows no sign of distress over the span.

Based on the success of this experiment, additional test installations are now being planned in Ohio and Illinois. Instead of using standard paving brick in basket weave pattern, large vitrified units 3½ x 8 x 8 inches have been manufactured. They will be laid by

hand in checkerboard pattern, properly spaced, and reinforcing rods placed in two directions in the cement grouted joints. Transverse expansion joints will be installed although volume change due to thermal expansion and moisture will be less than for concrete. A base course of the stabilized type will be used under some of the sections. This type of pavement will not require curbs or headers on the sides and it is estimated that it will be less expensive than the usual design. However, it should now be considered as having only an experimental status.

MAINTENANCE

Many of the early brick pavements were laid directly on a subgrade that had been evened up with a layer of gravel, sand, or screenings. Others, constructed before the great development in the volume and character of motorized traffic could be anticipated, had inadequate foundations. Surface irregularities have occurred, owing to uneven settlement of the base or subgrade under heavy traffic loads. The brick should be removed in the low places. The base may then be leveled up with some such material as lean bituminous cold patch or lean concrete having immediate stability. This leveling course over the undisturbed supporting material will provide a new base of even contour. In the future it will have less tendency to displacement than the original base, so that when the old brick are relaid and the joints filled, the new pavement will have increased value. It is a cardinal principle of road building that road surfaces should be uniform in character. It is well to keep this in mind when repairing brick surfaces.

It is a poor practice to patch brick surfaces with other materials. To try to fill depressions with thin layers of patching material is at best a temporary expedient. A small number of such patches will mar the appearance of a pavement which otherwise is in good shape. By taking up the brick and relaying it on the patching material as a leveling course, the proper surface contour is maintained and the less durable patching material is protected from traffic and the elements.

While in most cases the brick that have been removed can be re-used, there are times when for various reasons it may be necessary to supplement them with new brick. What has already been said in condemning the use of unsightly temporary patches has an application when new brick are used. The existing brick should be

matched as closely as possible in color and type. A skilled repair man can relay a patch so that in a day or so it will not be noticed. Careful workmanship in this respect is just as inexpensive as slipshod methods; in fact, it is more economical in the long run and infinitely more satisfactory.

When cracks in concrete bases are so wide that they permit the sifting-down of the cushion and dropping of the brick surface over the base crack, the surface should be taken up as soon as possible and relaid. The base crack should be filled in a manner similar to concrete pavement practice, and the new cushion preferably should be bituminous mastic. Where complete replacement of the concrete base is necessary, it is well to use high-early-strength concrete for base patching. The best practice requires that the new concrete base patch should extend under the edge of the adjacent old base. The brick can be taken up and relaid by "toothing-in" at least six inches back from the edge of the base patch. After the filling is completed, the repaired section is at once ready for traffic.

Uneven surfaces in some old brick pavements can often be traced to the shifting or settlement of the irregular bed or cushion. Such a condition can readily be remedied by removing the brick, adjusting or replacing the cushion, and relaying the brick to an even contour. The cushion when replaced should be thoroughly tamped, and if the unevenness is pronounced, the base should be brought to an even surface with bituminous patching and then a thinner cushion of uniform thickness used. Bituminous mastic is excellent cushion material for use in relaying uneven sections of brick pavement. Asphalt filler can be used successfully even if the original filler was cement grout. As a matter of appearance, however, the same filler as used originally is usually recommended. In all cases of patching, bituminous filler should be removed from the surface as in new construction. There should be the same care in the requirements for filler as in new construction. Filler that has disintegrated or melted and run out of the joints under the hot sun either did not meet the specifications in the first instance or was injured during application.

The time-honored definition of maintenance as the act of keeping the project in its original condition does not adequately fulfill the requirements. Considering the remarkable and continual change in motorized traffic, it is up to the maintenance engineer to endeavor to bring about an improvement in the old original condition. By

taking proper advantage of the adjustable elements and salvageable units of the brick pavement, he is frequently afforded such an opportunity.

Bituminous Pavements

In the field of bituminous pavements, the development of greatest significance has to do with the more extensive use of low-cost road-mix and plant-mix types of wearing courses for use on gravel, macadam, cinder, and earth bases on outlying residential and suburban streets.

In connection with hot-mix sheet asphalt and asphaltic concrete pavements, the control of cracking is probably the most important problem at present. Engineers have long realized that cracks of appreciable magnitude occurring in the foundation will invariably be transmitted through the asphalt surface course. In new construction such cracking may be practically eliminated by use of a flexible type base of asphaltic concrete or macadam. It is rather surprising that eastern and middle-western cities have not adopted the flexible base more extensively in view of the highly satisfactory performance of large yardages of such bases on the west coast.

When portland cement concrete foundations are used, cracking is to be expected and the problem then becomes one of crack control, so that overlying cracks in the asphalt surface course may be as narrow and regular as possible. Lean and relatively low tensile strength concrete bases, while cracking at perhaps more frequent intervals than rich bases, develop narrow cracks which are less objectionable when transmitted through the asphalt surface than the wide cracks which are apt to develop in rich mixtures. Natural cracks in the base are frequently irregular and ragged. Contraction of the concrete tears the asphalt surface and frequently produces even more irregularity and raggedness in the surface cracks.

The installation of thin strip metal contraction joints at regular intervals in concrete base is highly desirable. Such construction in East Providence, Rhode Island, by the State Division of Roads and Bridges, has demonstrated that transmitted cracks in the overlying surface may readily be kept to a maximum width of 1/16 inch, in practically straight lines at right angles to the center line of the pavement.[1] With such joints spaced 15 feet apart in a relatively rich

[1] "Experiments with Crack Control in Sheet Asphalt Pavements in Rhode Island," John V. Keily. *Proceedings of Association of Asphalt Paving Technologists*, January, 1937.

concrete base, the cracks in the overlying pavement have been nearly invisible. With lean mixes the joint spacing may be materially increased. The use of premolded joint filler along the curb line has also been found effective in allowing for free shrinkage in the sections separated by the metal plates, thus unifying joints and cracks.

Cracks in asphalt pavements, which cannot be attributed to foundation causes, may be due to faulty design of the mixture, poor compaction, or undue hardness of the asphalt cement.

Recent researches by Rader and by Raschig and Doyle show that those mixtures which are most resistant to cracking possess at low temperatures a relatively high modulus of rupture and a relatively low modulus of elasticity. From information at present available it appears that such characteristics are best developed by adherence to the following rules:

1. Use as soft an asphalt cement as possible without reducing stability below the minimum required to prevent displacement under traffic.

2. At paving plants prepare mixtures at the lowest practicable temperatures to prevent undue hardening of the asphalt.

3. Use as high a percentage of asphalt as possible, without reducing stability below the minimum required to prevent displacement under traffic.

4. Design surface course mixtures so that when thoroughly compacted voids will be reduced to less than 5 per cent.

5. Compress all paving mixtures to the maximum possible extent during construction.

When properly used in a well designed mixture, the asphalt cement hardens with age at an extremely slow rate. If the mixture is prepared at a high temperature or if it is not thoroughly compacted, the thin films of asphalt may harden appreciably due to contact with air. Most badly cracked pavements, upon extraction, yield an asphalt cement of less than 30 penetration, while those highly resistant to cracking are softer. As some hardening is to be expected during the mixing operation, it is highly desirable, except in continuously hot climates, to use an asphalt cement of not less than 50 penetration and preferably with a minimum of 60 or even 70 penetration.

In the asphalt surface treatment field there have been a number of developments during the past year. The following extract is

made from an article by Bernard E. Gray, Chief Highway Engineer of the Asphalt Institute, in the January, 1937, issue of *Roads and Streets,* pertaining to cut-back asphalts.

When the liquid asphalt specifications were adopted in revised form several years ago, the usual recommendation for asphalt primer was the MC-1 grade. However, subsequent experience indicates that there are many situations where the MC-2 grade should be substituted in its stead, the criterion being the presence of 200 mesh material. Thus for waterbound macadam with limestone, dense lime rock, dense top soil, dense sand-clay, etc. the MC-1 grade will function best as primer. With waterbound macadam of open texture as made from gravel, etc., the MC-2 material is to be preferred.

For seal-coat work there is a growing use of the MC-3 products, particularly where light treatments are desired, and where smaller size aggregates should be employed. There is a distinct advantage in using the heavier MC products for surface treatments where practicable, especially in climates subject to severe winter conditions, because the residue is a soft asphalt cement of around 200 penetration and thus more ductile under low temperatures. Such treatments are often applied over old dry-sheet asphalt and asphaltic concrete streets, as the kerosene type of distillate will cut back the old surface slightly and give a livening effect, so that cracks and crevices become completely sealed. The rate of application is seldom in excess of 0.2 gallon per sq. yd., and the aggregate cover should be approximately ⅜ in. maximum down to 20 mesh sieve.

The MC grades of cutback asphalts also are being used as winter cold-patch material, even with ¾ inch stone, and for the same reason as cited above, of having a softer asphalt residue. The binding action in a patching mixture is directly proportional to viscosity, and under winter conditions the binder in a patch cools rapidly before it has a chance to set, and therefore the asphalt residue should be distinctly softer than for summertime patching, so that during consolidation under traffic there can be rehealing and recementing of the particles, thus preventing raveling. MC-3 is recommended for at least a trial in such work in place of the RC-2 material so widely used for summertime cold-patch work.

In regard to surface textures, the past year's experience under the almost universal use of balloon tires, not only on passenger vehicles, but on trucks as well, indicates the desirability of finer textured surfaces. There can be no question that surface reaction under balloon tires tends toward tearing up rather than ironing out, and there is no need of constructing a coarser texture than desired in anticipation of closing up under traffic unless the surface underneath is so soft that the cover aggregate is driven into it by the weight of traffic. These factors should be evaluated prior to any retreatment operations, but in general the finer textures are to be preferred.

Very substantial mileages have been constructed of the road-mix type during the past year, but with relatively few changes from methods previously described. One modification is to be noted in regard to the dense graded road-mix, which is for the same reason discussed under primers in a previous paragraph. Early recommendations for dense grade aggregate called for the MC-2 grade of kerosene cut-back asphalt as binder, and from 8 to 14 per cent of 200 mesh mineral filler. As a result of experimental construction, it has been found that with glacial gravels or crusher-run stone containing little or no 200-mesh material, entirely satisfactory mixtures will be obtained through use of higher viscosity asphaltic materials. MC-3 is therefore recommended for use where little or no 200-mesh material is present in dense graded road-mix construction.

Experience has added further to knowledge concerning behavior of various kinds of coarse aggregate in road-mix surfaces, particularly in respect to their absorptive character. It is not always possible to determine from the screen analysis alone just the type of bituminous material to be used, and with soft chalky limestone or very absorptive stone of any character it is often better to use an MC product rather than an RC product, because either the dust on the stone or the stone itself will rapidly absorb the distillate, thus setting up the MC product, while with a non-absorptive stone a rapid curing asphalt would be required. There is a further advantage in using the MC products with soft aggregates, because the latter tend to break under traffic, and with the soft asphalt residue present there is a rehealing action which does not obtain with hard asphalts.

INVERTED ASPHALT EMULSION

Considerable interest has been shown in what is called "Inverted Asphalt Emulsion." This emulsion is made by emulsifying a cut-back asphalt (85-100 penetration asphalt cement plus naphtha) using corn oil or soya bean oil as the emulsifying agent. The emulsion is then inverted by the use of aluminum sulphate. An inverted asphalt emulsion is one in which the asphalt is in the continuous phase and the water is in the dispersed phase. A normal asphalt emulsion is one in which the water is in the continuous phase and the asphalt is in the dispersed phase.

Inverted asphalt emulsion, which is composed of approximately 75 per cent asphalt, 20 per cent naphtha and 5 per cent water, is supposed to combine the properties of a cut-back asphalt and an asphalt emulsion, in that it will cover both dry and wet aggregate equally well. One advantage of inverted asphalt emulsion over the normal type of emulsion is its immiscibility with water, which prevents dilution when in contact with wet aggregate. The setting

property of an inverted asphalt emulsion is due to the mechanical squeezing out of the water under the roller and to the evaporation of the naphtha, leaving an asphalt cement of 85 to 100 penetration.

The City of Pittsburgh specifications for Inverted Asphalt Emulsion (cut-back emulsified asphalt) are as follows:

This material shall be a cut-back emulsified asphalt prepared by compounding a suitable volatile naphtha with an asphalt, meeting the requirements of the Commonwealth of Pennsylvania, Department of Highways Specifications, form 408, Volume 1, July 1935, for Asphalt Cement, BM-1. The viscosity will be subject to variation within the limits designated as may be directed.

	Minimum	Maximum
Miscibility with Water		None
Stone Mixing Test	Must thoroughly coat wet aggregate	
Settlement Test 5 days at 77° F.	None	None
Freezing Test (15 hrs. below 30° F.)	Homogeneous	
Furol Viscosity at 104° F. Sec.	400	2200
Evaporation Loss (A.S.T.M. Oven)	15%	35%
Naphtha Content	10%	30%
Water Content—Xylol distillation	4%	12%
Ash	0.2%	1.0%
Flash—Open Cup (tag)	110° F.	
Tests on Residue		
Specific Gravity at 60° F.	100 Plus	
Per Centum soluble in CS_2	98.0	

TAR

The increased use of tar in the building of low-cost roads has led to new and improved tar specifications. The American Society for Testing Materials and the American Association of State Highway Officials now have under consideration revised specifications under which either coal or water gas tar may be furnished. The advent of heavy water gas tar with its higher free carbon content has been instrumental in bringing about the demand for combined specifications.

Retread work with tar products continues to be a favorite resurfacing method. The practice is to use as heavy tar as can be readily handled on the road. Heavier and better mixing machinery has made possible the use of the heavier grades. Double sealcoating is recommended in order to thoroughly fill the surface voids so that

a tight impervious surface is obtained. The practice in some states and cities is to apply the final coating of tar without cover in order to avoid having loose material on the surface when the job is finished.

CONSTRUCTION METHODS

There seems to be a definite trend toward plant mixing for bituminous material as against the road mixing method except in cases where the recently developed road mixing machine of the pug-mill type is available. The remarkable increase in the use of bituminous material for low-cost pavement has resulted in the establishment of plants in almost every community of any size so that the plant-mix type of material is now available where before it was not. This applies particularly to cold mixtures. The plant-mix material has a definite advantage over the road mix in that there is better control of the proportioning and complete covering of the mineral aggregate.

SOIL STABILIZATION

Increasing attention is being given by engineers to the importance of soil stabilization. Fundamentally soil stabilization is any method whereby the condition of optimum moisture content is maintained in a large measure throughout the year. A method of soil stabilization should be determined only after a careful examination of local climatic conditions and the availability of stabilizing materials. Soil stabilization with bituminous materials has taken two principal forms—one the so called sub-oiling method, the other the mixed method. Either method applies to all kinds of soils ranging from pure clay to almost pure sand.

Where sandy soils are experienced the mixed method is the general practice because of the rapidity of mixing operations with multiple blade graders and other blade equipment. The sub-oiling method is used principally with the clay type of soil and appears well adapted to this purpose. The use of cement for stabilizing subgrades or earth roads is receiving increased attention. Soil cement roads bring to the light traffic secondary road field a superior low-cost all-weather surface applicable to unimproved streets in outlying sections of many communities. Such stabilized roads provide an excellent base for a more permanent pavement when traffic demands increase.

Sewage Treatment

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IN REVIEWING the status of sewage treatment in the United States during the year 1937, it may be stated that few, if any, radical departures from previously established practice can be noted.

For conditions requiring complete biologic treatment of sewage, the activated sludge process apparently continued in popular demand, and many plants employing this process were either completed or placed under construction during the year 1937. It would further appear that this process has, to a large extent, supplanted the formerly widely used settling tank and trickling filter type of plant.

In the case of the larger activated sludge plants which have been constructed, compressed air has continued to find favor as the oxygen supply medium, while in the case of the smaller activated sludge installations, plants of the mechanical aerator type have been used. In this type of plant, surface absorption of atmospheric oxygen by the sewage supplies the necessary oxygen for producing activated sludge. A high standard of effluent is obtainable in the case of either type of activated sludge installation, if tank proportions are adequate and operation is properly controlled. In the case of mechanical aerator plants, considerably longer aeration periods have been found to be necessary, as compared with the compressed air type of plant, resulting in more extensive tank structures for a given sewage flow volume. The cost of operation, however, in the case of mechanical aerator plants is, as a general rule, less than that for the compressed air type.

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It is particularly important where comparatively small sewage flows are involved, to predetermine the character and extent of wastes of objectionable nature which may act as deterents to producing and maintaining a satisfactory character of activated sludge. A preponderance of acid, milk, or laundry wastes, if not neutralized or otherwise pre-treated at its source of production, may easily result in unbalancing the operation of a small activated sludge plant, with a resulting poor quality of effluent.

For conditions requiring intermediate degrees of sewage treatment, chemical processes have frequently been employed, as have also plain settling tank forms of treatment supplemented by effluent filtration through Magnetite filters. These types of treatment depend for results, which are obtainable through their use, upon physical and mechanical removal of sewage solids, as differentiated from the higher biologic and colloidal removals obtainable through the use of the activated sludge and trickling filter processes.

In instances where primary treatment alone has been considered adequate for conditions dealt with, plain sedimentation tanks of either the rectangular or circular type have met with continued popular favor. The one-time popular Imhoff settling tank appears to have been largely supplanted by plain sedimentation tanks and separate sludge digestion. Chlorination of plain settling tank effluent has been employed in many instances, particularly during the critical warm months of the year, to assist the receiving waters in assimilating and oxidizing the partially treated plain sedimentation tank effluent.

So-called primary treatment plant facilities are, in the majority of instances, so designed and constructed as to serve as preliminary adjuncts to the subsequent installation of more complete treatment, at such time as increased sewage loadings may make more extensive treatment a necessity. Such procedure obviously possesses economic advantages.

Within recent years, marked developments have been noted in treatment plant mechanization, this development having been particularly prominent in such plant necessities as mechanical sewage screens, sludge removal mechanisms, and mechanisms for the removal and cleansing of grit in instances where grit chambers are employed.

In the matter of treatment plant control and operation, it may be pointed out that marked advances have been noted during

recent years with resulting economy and increased operating efficiencies. A major contributing factor in this direction has been the establishment of policies by various state health boards for the training and licensing of treatment plant operators. The average sewage treatment plant today is looked upon by municipalities as a very much worth-while utility, pointed to with pride. This present-day attitude appears to be in decided contrast to that of a few years back.

Separate Sludge Digestion

Separate sludge digestion under conditions of temperature and pH control continues as the popular method of preparing sludge for subsequent partial dehydration, either through the use of sludge drying beds, or vacuum sludge filters. The commercialization of sewage sludge fertilizer in the competitive fertilizer markets is the exception, rather than the rule, in the matter of sludge disposition, although in many instances, dried and unprocessed sludge as removed from beds is disposed of locally as a fertilizer material, with some resulting revenue. The nitrogen content of sludge, its volume, and the geographical location of a municipality, are matters of fundamental consideration in connection with sludge commercialization.

Where digestion is employed as a sludge reduction process, the resulting nitrogen content of the end product is relatively low as compared with initial nitrogen content of the raw sewage, the greater part of the initially present nitrogen having been removed in the digestion process as a result of the gasification of volatile matters. In instances where vacuum filtration of raw activated sludge is employed in lieu of digestion, nitrogen content of the end product is more nearly comparable with that of raw sewage, although at Milwaukee, where sludge fertilizer production is practiced on a large scale, a substantial portion of the initially present nitrogen is consumed, or otherwise liberated in the aeration process and in the subsequent heat drying process.

During the year a number of municipalities adopted incineration as a method of sludge disposal, and the indications are that this method may find continued favor. The ash resulting from sludge incineration is largely an inert material, and may be disposed of without resulting nuisance from odors. Also, economies in operation may be afforded through the utilization of sewage

sludge gas as a fuel, although it has been customary to resort to the use of oil as the main source of fuel supply. Waste heat from the incineration process may be recovered and serve a useful purpose in connection with a hot water supply system.

It appears to be indicated that sewage treatment practice of the future may involve the treatment of ground garbage in combination with sewage to a greater extent than has been the case in the past. Treatment plants wherein this form of combination treatment has been practiced report increased gas production in the process of sludge digestion, little or no increase in solids contained in the effluent, and an inappreciable increase of B.O.D. in the effluent. The low pH of garbage may be expected to assist in the removal of solids in primary sedimentation tanks. Caution should be exercised by the engineer in cases where combination sewage and garbage treatment is contemplated not to over-proportion garbage volatiles to sewage volatiles, although it is believed that in the majority of instances the normal rate of garbage production would not result in such over-proportioning.

The economic utilization of sewage sludge gas obtained through the use of sludge digesters has received much attention during recent years, and development in this particular phase of sewage treatment may be expected to continue. The development of the engine utilizing sewage sludge gas as fuel has been marked, and this form of equipment has found rather widespread use both as a prime mover for generating electric energy, and for driving blowers where compressed air activated sludge plants are employed. Through the use of heat exchangers which absorb heat from the exhaust gases, operating economies have been effected in the matter of supplying hot water for circulation through digester tank coils and also through heating systems located in treatment plant housing structures.

During the latter part of 1937, fewer new treatment plant projects appeared to be under contemplation than had been the case for many months previously, although many municipalities which have not as yet taken up actively the matter of providing sewerage and sewage treatment facilities are under state board of health orders to proceed with the installation of such facilities. Forecasts as to the extent of sewerage work to be undertaken by municipalities might therefore be made largely upon the basis of state board orders which have not as yet been complied with.

Financial restriction in many instances may tend to delay the carrying out of such orders in full, although it would appear logical to assume, under the circumstances, that sanitation work in part, at least, might be given initial preference as funds may become available. The matter of alleviating conditions of pollution of human and industrial origin in natural bodies of water is commanding the attention of sanitarians more and more as time goes on, and there appears to be no reason for assuming that the momentum will not continue indefinitely.

Water Works Practice[1]

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Water works practice is not static, and progress is being made in all its branches. Because of the evolutionary character of the developments in this field, it is difficult to distinguish between current year advances and those which are the culmination of several years' progress. However, certain trends in practice are discernible and warrant discussion; this report briefly reviews these and records some specific examples of practice observed during 1937.

The most notable of the year's experiences include: the flood on the Ohio River; researches on taste and odor control, coagulation, and corrosion; the development of two municipally controlled industrial water supplies; improvements in elevated tank design and pipe line construction; and the numerous water works projects completed.

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[1] A more extended treatment of this subject was presented by the chairman in an article which appeared in *Water Works and Sewerage,* January 1938.

* Committee on Water Works, 1937

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Results of Ohio Flood

Communities in the Ohio River Valley experienced the worst flood in the history of this region, in January 1937, with flood crests far exceeding any that had ever previously been recorded. Water service was forced to be suspended in over one hundred communities for periods varying from a few days to several weeks. An important lesson learned from this experience is that the time to protect against a flood is before it occurs. Numerous plants are now being so protected. Evansville, Indiana, is constructing an earth enclosure around its pumping station and filter plant that is six feet above the 1937 flood crest. Louisville, Kentucky, is calling for bids on deep well pumping equipment which will be installed with motors set well above any flood height. Cincinnati is also preparing its plant to cope with even greater floods than that of 1937.

In this connection, the flood emergency demonstrated the importance of having reliable stand-by pumping equipment, especially in pumping stations operated by electricity supplied by an outside source. The year 1937 produced further developments in auxiliary pumping equipment suitable for stand-by service. Larger gasoline engines (up to 450 H.P. capacity) for driving centrifugal pumps are now available. Also, several lighter types of Diesel engines have been brought out by manufacturers.

Progress in Water Treatment

A considerable amount of attention and study has been given in the past few years to the pretreatment of water, the more diversified use of coagulants, the elimination of tastes and odors, the problem of corrosion, and so on. These efforts to improve the quality of water to a high degree of perfection have continued to receive marked attention this past year. Many researches are being conducted and they are producing important information of untold value to the water works profession. To the researchers performing this work, the profession is greatly indebted.

Pretreatment. The pretreatment of water continues to receive considerable attention in the effort to reduce the turbidity of the water going to the filters. In practically all sizable plants mechanically operated mixing and stirring equipment is being installed to improve and economize in coagulation. Flocculators are coming into general use. Coagulants are being more extensively used and

methods are being studied and developed to aid coagulation in water which is hard to coagulate. (See series of articles on "Coagulation" by Baylis, in *Water Works and Sewerage,* December 1936, et seq.)

Filter Sands and Surface Washing. With the greater degree of perfection in the pretreatment of water, specifications for filter sand now generally permit a coarser size than formerly. Filter plant operators are paying more attention to the condition of the sand beds and cleaner beds are being maintained. In the Great Lakes region, the value of surface washing of filters to prevent mud balls and the cracking of beds has been clearly shown. The plants at Racine, Kenosha, Milwaukee, and other places utilize this method of controlling the condition of filter beds. The wash water is generally applied through a series of holes in 1- to 2-inch pipes spaced about three feet apart. These pipes are about one inch above the bed when filtering, but when the bed is expanded in back washing, they are several inches below the sand surface. During the year an Ohio River plant, which had experienced difficulty with mud balls, installed surface washing equipment which successfully eliminated the trouble. Other plant operators might wisely investigate the possibilities of this process.

A very useful method to determine the condition of filters has been developed by Baylis and from the results of his experiments he has compiled a table classifying filter beds based upon the percentage of mud balls present. Further tests made by the Illinois Public Health Department on about forty plants revealed a very close relationship between the appearance of filters and the condition as indicated by the mud-ball test.

Filter Plant Design. Further improvements and innovations in the design of filter plants continue, notably the all-steel tank type of treatment plant and Milwaukee's use of two-story coagulation basins. Plant operators and designers will watch with interest the results of the operation of these plants. In St. Petersburg, Florida, a unique filter plant has just been completed consisting of a series of steel tanks above ground which comprise the various basins and filters.

Other problems in filter plants are being attacked and solved. For example, several expedients are being tried to overcome the difficulty of condensation in a filter plant. This has always been troublesome to the operators. In the new Milwaukee plant, parapet

and curtain walls have been erected in the filter gallery and radiators have been placed so as to limit the movement of air across the filters. In the plant at Ottawa, a glass partition has been placed between the operating gallery and the filters. It has been observed that unit heaters are undesirable in filter plants from this point of view. Another method to reduce condensation which is being tried is the use of cork insulation material in the roof of the plant.

Floc detectors, and indicators on hydraulic valves to show the position of the valve opening are now being installed in most new plants to assist operators and promote better handling of the plants. Not long ago it was reported that a sand bed expansion indicator had been developed at the Allentown, Pennsylvania water plant.

Taste and Odor Control. Greater freedom from taste and odors still continues to be the goal of the water works profession and, as a result, the palatability of water supplies further improves. Especially interesting is the installation, during 1937, of granular carbon filters at Oshkosh and Neenah, Wisconsin. Powdered carbon is still used ahead of the sand filters to do most of the work, but to insure the positive elimination of tastes and odors the granular carbon filters are employed as the last step in the treatment.

Corrosion and Sterilization. The prevention of corrosion and the insurance of a more sterile distribution system have received greater attention during the year. Experiments in corrosion control were begun in 1937 at Columbus, Ohio, and this study is still under way. The results of this investigation to date have tended to explode some of the generally accepted theories on corrosion. The answer to corrosion control has not yet been found, but the very fact that a problem is being vigorously studied is a sign of progress. More is being heard of the sterilization of distribution systems by the ammonia-chlorine treatment. The carrying of residual chlorine through the system not only safeguards the consumer but controls to some degree the bacterial growths which lead to corrosion and taste and odor troubles.

Industrial Water Supplies

A most significant development in the water works field in 1937 was the construction of two large municipally operated and controlled industrial water supplies—one at Charleston, South Carolina, the other at Birmingham, Alabama. The project at Charleston was an extension of the existing municipally owned plant, involving

an expenditure of approximately $1,000,000. This enlargement was made to bring a large industry to the city. Entirely different circumstances prevailed at Birmingham where the domestic supply is furnished by a private water company. In order to make possible the further industrial growth of the city, it was necessary to construct an entirely separate water supply for industrial users. A semi-public commission was chartered to develop the needed supply which involved the construction of an impounding reservoir, forty miles of welded steel pipe line, and a distributing reservoir. The project, which cost about $6,000,000, was financed by the sale of city bonds supported by the revenue derived from the operation of the system. [Note.—See article on the Birmingham project at page 274.—*Editor*]

Pipe and Elevated Tanks

In the construction phase of the water works field, the year 1937 witnessed an increased use of transite pipe, cement-lined pipe, and steel pipe with bituminous coatings in the larger sizes. More attention is being paid to the selection of bituminous materials for coatings. Cast iron pipe is still the most widely used in sizes 36 inches or less in diameter. A more extended use is being made of cement-lined pipe in localities where active water is present. Transite pipe with its advantages from the standpoint of shipping, strength, reliability, and uniformity has been more widely used, especially in the past two years. While reinforced concrete pipe is used extensively in the larger sizes, steel pipe coated inside and out with bituminous (tar base) material is coming into more general use. Such pipe is now manufactured in all sizes, but a very limited use of it has been made in sizes under 24 inches.

A number of cities increased the flexibility and otherwise improved their distribution systems in the past year, by the construction of elevated tanks. There have been many improvements in the design and appearance of these tanks in the last few years. Welded construction is fast superseding the riveted type and has proved advantageous, resulting in better appearance, water-tightness, and greater safety.

Further Developments

The problem of providing adequate protection of water works employes by some form of pension or retirement system is receiving

greater attention. The enactment of the Federal Social Security Act —the provisions of which do not include public employes—has served to emphasize the desirability of such protection, and has stimulated consideration of the problem by municipal officials and the public. Many cities already have similar provisions for its employes in operation, and others are planning to adopt such measures.

The number of municipally owned water works has increased, during the year just ended, through the purchase, by several cities, of the plants of private water companies. A favorable factor influencing such purchases by municipalities was the low interest rates which prevailed. More than 80 per cent of the water works in this country are now municipally owned.

Street Cleaning

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STREET cleaning organizations are still feeling the effects of depression curtailment. Many cities are facing another year without receiving any substantial increase in appropriations and without restoring essential street cleaning services. This does not mean at all that municipal streets are generally dirty, for many communities are doing a surprising amount of work with the funds that have been made available. It does mean, however, that pavements for the most part are not cleaned as frequently and sometimes not as well as the officials and citizens would like, and often not up to a standard of cleanliness necessary for the general public welfare.

In one sense, the drastic reduction in street cleaning appropriations has had beneficial results; in many other ways it has been

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extremely detrimental. The operations have become more effective and efficient through the desperate efforts of the officers responsible for this work to make the available funds go as far as possible. To a large extent, many of them have been able to eliminate unsound practices and methods and have improved the service through better planning and programming. On the other hand, the street cleaning function has been seriously harmed by the excessive reduction of vital and valuable activities. In some places the street cleaning program has been set back at least ten years. Educational programs had to be abandoned and the effect of the past work is virtually lost. Citizens, lacking the necessary example of cleanliness on the part of the city, have become more careless about littering the streets. From an aesthetic and sanitary viewpoint, it may take a long time to recover the lost ground and to make our cities as clean and neat as before.

Administration of Street Cleaning

In recent reorganizations new trends are not particularly noticeable. The street cleaning agency is almost always allocated in a department of public works if there is one, otherwise in a street department. A few cities have created separate departments of sanitation to handle the street cleaning and refuse collection and disposal work. The street cleaning unit is usually headed by an officer whose sole responsibilities are to keep streets and catch basins clean, to remove snow, and to protect icy streets. Such an officer may be subordinate to a higher official who may also control other activities, but it is now generally regarded unsound to assign other than street cleaning duties to the employe immediately in charge of the street cleaning unit.

There are still several cities in which the street cleaning work is divided between two departments, and there is apparently no tendency toward the consolidation of such forces. In a typical case of such divided responsibility, a park department or board has a force to clean the boulevards and park drives, while a public works department maintains an entirely separate force and equipment to clean the other city streets and alleys. It would seem that the work could be done better and less expensively under a single agency.

The relief labor situation still is strongly influencing street cleaning administration. The policy of using hand rather than machine

methods so as to employ a greater number of persons still persists in many cities, although it is maintained by several outstanding administrators that if all factors could be evaluated, it could be demonstrated that such cities probably suffer a net loss. Furthermore, the practice of hiring physically and mentally unqualified employes because they are otherwise unemployable, because they are on relief rolls, or because they are politically favored, is still all too common, and is preventing improvements in street cleaning which would otherwise be possible. This is demonstrated in those cities that do select street cleaning employes solely on their ability to do the work required.

Recently there has been a renewed interest in uniforming the street cleaning employes. The forces of numerous cities wore uniforms prior to the depression, but except in very few places, the practice was abandoned because of the inability of the workers or the cities to meet the extra expense. Uniforms are favored primarily to promote the safety of the workers, but also to improve the morale of the personnel. Several officials have indicated that their forces will be uniformed as soon as funds can be made available.

Methods and Equipment

Street cleaning methods are more often determined by the local conditions of automobile parking than through the selection of the most economical methods. Uncontrolled parking is still the greatest problem that many street cleaning officials have to face and it is responsible for much of the inefficiency and lack of effectiveness that exists. The people of American cities are paying high prices for the privilege of unrestricted street parking. The methods that must be used to clean streets on which cars are always stored are far more expensive than would be necessary if such streets could be totally cleared for as little as two hours a night. Furthermore these costly methods do not clean the pavements as thoroughly as would otherwise be possible. The communities that do control parking, particularly at night, are in an enviable position as far as street cleaning is concerned and it is doubtful if individual liberty in these places is particularly thwarted.

Hand methods are still widely used. In most cities a part of the cleaning work is done by block patrolmen or gangs of sweepers.

The block patrolmen, sometimes called white wings, usually work in the congested areas, particularly in cleaning the gutters around parked cars and in collecting the litter that is constantly being deposited during the day time. Sweeper gangs are not used as much as formerly or as generally as the block patrol plan. This method is confined largely to residential streets and alleys. The use of manual street sweeping is probably decreasing although the rate of decrease is extremely slow.

Many of the larger cities flush the business and main arterial streets regularly. Some officials believe that flushing is the only acceptable method for cleaning pavements that have cars parked on them at all times because the sprays can partially clean the surfaces under the vehicles. Flushing generally, however, has decreased during the past few years. Numerous cities that formerly flushed pavements after they were swept in order to remove all of the dust and fine dirt, have abandoned the final cleaning because funds were not available. There is no apparent indication that such cities are ready to resume the use of this method.

Many smaller municipalities do all their street cleaning with motor pick-up sweepers. Likewise a large number of the more populous communities use this method wherever local conditions permit. Pick-up sweepers are being somewhat more widely used, though the increase is relatively small, largely because of the parked car situation and the persistence of local officials in retaining manual methods.

Planning Street Cleaning Operations

One of the most encouraging signs in the field of street cleaning is the recognition by a great many officials that street cleaning must be approached scientifically, and that broad plans and detail schedules and programs must be carefully prepared for each city on the basis of the local conditions encountered and the funds available. It has been demonstrated that the only way a street cleaning official can know that he is giving maximum service with the means at his command is by establishing operating procedures on the basis of the sound detailed analysis of the entire problem. Broad plans are necessary to the successful administration of any function, but they are only a part of the whole task of planning. The directive planning of street cleaning operations reduces the problem to its elements and permits each to

be studied separately. It makes the best use of the street cleaning executive's judgment and eliminates the necessity of making guesses which would inevitably be required if the problem were attacked as a whole.

Through sounder planning, many cities have been able to reduce street cleaning expense by applying the proper methods to individual streets or districts, by fixing the frequency of cleaning of each street on the basis of actual need, by cleaning streets when conditions are most favorable, and finally by arranging the cleaning routes intelligently after the problem has been studied in detail. The old way of treating entire cities or districts as a whole in considering methods, frequency of cleaning, and time of cleaning is now known to be extravagant and ineffective.

Reducing the Amount of Litter

It has been observed that cities generally have lost much ground in the fight to keep the streets neater and more free from the litter which is carelessly thrown by citizens onto pavements and sidewalks. Some cities, such as New York, Pittsburgh, and a few others, have been able to carry on their programs of public education. Other cities that have abandoned such programs, or that never had embarked on public educational work of this nature, face the task of renewing or adopting measures to reduce the amount of litter on public ways if the communities are to appear neat and clean and if they are to get the most from each street cleaning dollar. The three methods that have produced the best results in preventing refuse from being carelessly deposited in streets, are as follows:

1. Changing public attitude toward street littering through well planned, intensive educational campaigns in the schools, churches, civic clubs, and generally through newspapers, theaters, and the like.

2. Providing a large number of litter cans or baskets at convenient and strategic points so as to make it easy for citizens to put waste materials in such containers rather than on the streets.

3. Adopting and enforcing ordinances that make it an offense to discard refuse or litter on public streets or alleys.

While it is generally recognized that such ordinances are necessary and desirable, they are usually used only in cases where other methods fail to produce results. Education programs are generally

held by street cleaning officials to be the best and most effective means.

Snow Removal

Snow removal operations are rapidly assuming greater importance to the cities in the snow belt. Acting on the persistent demands of motorists, business men and other citizens, most cities have expanded and improved the services provided to plow snow from the traveled portion of pavements, to remove the snow from the streets, and to eliminate icy conditions on street surfaces. Although such work is necessarily of an emergency nature, it has been found that extensive and detailed plans can be made to insure the prompt, effective and efficient conduct of snow and ice operations, and that without complete and carefully prepared plans little short of chaos can be expected. Many cities have made careful studies of their snow removal situations. They have developed organization plans; made arrangements for personnel; instructed each regular employe in his duties during the emergency periods; provided for the necessary equipment, supplies, and materials; and coordinated the snow removal work of other agencies with that of the city.

Much progress has been made in the protection of icy pavements so as to prevent accidents and make the full-time use of city streets possible. This service has extended rapidly and many cities have provided for the prompt application of sand, cinders, salt, calcium chloride, or mixtures of such abrasives and chemicals to provide tractive street surfaces. Emergency supplies of materials for hand spreading have been placed in strategic locations. The use of mechanical spreaders is being widely adopted.

Further developments in this field are expected. It is generally felt that snow removal measures far beyond those now provided are economically sound. The interference with emergency municipal and health services, the huge losses to business, and the endangering of pedestrians and vehicle users occasioned by large snow storms cannot be tolerated in a modern city.

Refuse Collection and Disposal

Samuel A. Greeley

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Chairman of and Reporting for the Committee on Refuse Collection and Disposal *

While it is always difficult in the field of refuse collection and disposal to appraise the developments of a single year and to sense the current trends with any degree of accuracy, it is worth while to record and briefly describe some of the more important events and their significance as regards current trends in organization, design, construction, and methods of operation. One of the most encouraging aspects is the general acceptance on the part of public officials and citizens of the real connection between public health and the handling and disposal of refuse. The public and its officials give evidence by the work of the past year that they realize that the progress and health of their communities depends to a considerable extent on the promptness and effectiveness with which refuse is collected and disposed of. This attitude assures more stable policies and continuing programs and permits the development of sounder organization plans with more permanent and better qualified administrators and employees. The result is a better selection of suitable collection equipment and disposal methods based on more comprehensive and long-range plans.

Collection of Refuse

Although there was no very great development in collection methods during the depression years, there was a considerable advance on the part of manufacturers in the design of collection equipment. It is now apparent that many cities are taking a renewed interest in modernizing and extending their services. The

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number of recent engineering surveys indicates that cities are becoming interested in providing not only more complete collection of household refuse, but also in improving house treatment by the use of more sanitary receptacles. Some cities which in the past have collected only certain kinds of refuse, as, for instance, garbage and rubbish, have upon investigation concluded that an extension of the service is desirable. A survey in Pittsburgh by the Department of Public Works indicated that the cost of collecting ashes would be very little if any more than the present costs resulting from the necessary clean-up of streets, catch basins, sewers, and vacant lots caused mainly by the lack of a general ash collection service. It was further indicated that because in Pittsburgh the collection of garbage and rubbish was by contract, and because inevitably some ashes were collected with the garbage and rubbish, the city would in effect be saving some contract costs of collection, which is on a tonnage basis, by collecting ashes itself. In Baltimore the city has recently taken over the collection of rubbish.

House Cans

There has been continued interest in the house can or receptacle. The difficulty of having all citizens provide suitable house cans was emphasized during the depression. In recent studies at Montclair consideration was given to: (a) the actual ownership of the cans by the municipality; (b) the renting of standard cans to householders; and (c) the extension of the collection service from the curb to the back porch or yard.

Some consideration has also been given to the exchange-can plan as used in Lansing. Under this plan the cans are collected full and taken to a transfer station or disposal plant to be emptied and cleaned. A clean can is left at the house when the full can is removed.

Collection Equipment

A trend which is continuing and appears to be increasing is the use of the so-called dustless type of collection vehicle. There are a number of such collection vehicles on the market which comprise covered bodies with low loading heights and which dump readily. They are designed to permit the loading of refuse without spilling any part of the contents of the cans and thus they

eliminate dust from ashes, loose papers from rubbish, and drippings from garbage. In the main, motorized equipment is being used but recently some new horse-drawn equipment has been put into service in Philadelphia. A large metal box equipped with tight covers is carried on a horse-drawn cart for collection service. When the box is filled it is hauled to a transfer station where a crane lifts the box, empties it into a larger motor vehicle, and then replaces it on the cart. In the determination of truck sizes and refuse collection equipment, consideration is being given in some places to the use of such vehicles for other more or less intermittent service as, for instance, snow plowing and snow hauling.

Disposal of Refuse

There has in general been an extension in the disposal of garbage and rubbish by incineration. The increasing lack of adequate dumping areas and the growing objections by citizens to nearby garbage dumps, together with the order of the Supreme Court to New York City to cease dumping such refuse at sea, have been factors in the increased use of incineration.

There is a noticeable tendency for municipal officials to avail themselves of qualified and experienced engineering service in the design and construction of refuse disposal plants. New York City has a highly qualified engineering department for the design and construction of the large refuse incineration plants recently completed in that city. Other cities have employed experienced engineers for this service. In general, the design has improved, particularly as regards the removal of odor hazards and the maintenance of clean premises in the vicinity. Some expensive and annoying delays have been occasioned by objections of property owners to the proposed locations of refuse incinerators but in the main the courts have recognized that modern incinerators can be operated in an unobjectionable manner.

It is interesting to know that the new incineration plants at Providence and Rochester are designed to produce steam, the one at Rochester delivering the steam to the adjacent garbage reduction plant. However, the plant at Rochester is designed to burn rubbish and not a mixture of garbage and rubbish.

It is of interest to note that with the aid of the W.P.A. experiments have been carried on at Milwaukee with reference to

the salvaging of some material from the rubbish. The objective is to reduce the load on the incineration plant and on dumping areas by removing for sale such items as scrap metal, tin cans, and rags. So far there has been no actual construction but the experiments are said to have been promising.

Disposal of Garbage By Hog Feeding

While this method of disposal does not seem to have been extended it will be of interest to those cities where it is practiced to review the reports of the United States Public Health Service and the Bureau of Animal Industry regarding trichinosis. These reports appear to indicate that garbage-fed hogs are a more dangerous source of trichinosis than corn-fed hogs. The report indicates, however, that to thoroughly cook pork remains the only assurance of safety.

Disposal of Garbage with Sewage

There has continued to be much interest in the possibilities of disposing of garbage with sewage. The recent installation of a number of sludge incinerators at sewage treatment plants has suggested the possibility of disposing of some garbage with the sludge. In one plant provision is made for mixing raw or ground garbage with the sludge cake and delivering the mixed material to the incinerator. In another plant ground garbage is to be delivered into the sludge digestion tanks for disposal, and in still another ground garbage is to be discharged into the sewage and passed through the treatment plant for disposal. Operating results with these various methods will be awaited with great interest.

Traffic Safety[1]

BURTON W. MARSH

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Chairman of and Reporting for the Committee on Traffic Control, 1937*

WITH the growing intensity of traffic problems, there is developing the widespread realization that the scientific approach of the trained traffic specialist is needed. In recent years, and especially in 1937, there has been an increasing amount of attention devoted to the important public problem of traffic control. A number of national organizations are stimulating progress in this field through the provision of funds for various activities, the issuance of awards for particularly good work, and through contests among interested parties or communities. There is an increasing demand for the creation of better administrative machinery and for improvement in traffic control and traffic handling measures. There has been a growing realization and acceptance of responsibility by governmental agencies for providing adequate traffic facilities and controlling their use.

The recent past has produced greater activity in traffic surveys and researches as well as a highly encouraging increase in the training of individuals for various phases of a well-rounded traffic improvement program. There have been some interesting developments in traffic control devices and methods as well as important developments in the field of highway design.

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[1] This report, presented in tentative form herewith, is being developed into a joint report for the American Public Works Association and the Institute of Traffic Engineers, by a joint committee which has the same membership as the committee on Traffic Control of the A.P.W.A. under chairmanship of Burton W. Marsh. Mr. Maxwell Halsey, a member of this committee, is serving as co-chairman of the special joint committee for the purpose of preparing this report.)

*COMMITTEE ON TRAFFIC CONTROL, 1937

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Maxwell Halsey...... *Cambridge, Mass.*
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Traffic Improvement Activities

During the past few years, and especially in 1937, there has been a great increase in the stimulation of activities designed to improve traffic conditions and reduce traffic accidents. The following brief resume of some such activities will illustrate this point:

A. Federal Assistance to State Highway Planning Surveys

The U. S. Bureau of Public Roads developed a standard pattern for state highway planning surveys, including an inventory of road facilities, a series of traffic studies, and financial studies which involved road-life studies. Forty-three states have such highway planning surveys in operation, and two additional states have preliminary plans completed. In twenty-one of the states additional funds were deemed necessary and these were obtained from the W.P.A. Nearly $3,000,000 of such extra moneys have been obtained.

B. Federal Assistance to Other Traffic Surveys

The several federal work relief programs have offered a great stimulus to the making of traffic and transportation surveys by providing a considerable portion of the necessary funds. Two hundred and sixty-five communities submitted acceptable applications under F.E.R.A., C.W.A., or W.P.A. work relief programs. While a number of earlier relief-manned surveys were not as adequately planned, supervised, analyzed, and interpreted as they might have been, there were others which produced very worthwhile results. Since the beginning of 1937, the W.P.A. has insisted on the provision by communities of competent technical supervision.

C. National Traffic Safety Contests

For several years the National Safety Council has sponsored traffic safety contests and annual awards among cities classified in several size groups. Recently, the contest has been extended to states. Much credit is given in this competition for effective traffic engineering and for other evidences of scientific approach to traffic problems.

D. Program of Automotive Safety Foundation

The Automotive Safety Foundation was organized in June 1937 to help encourage safe and efficient use of streets and highways

and to help accelerate and extend approved programs dealing with traffic efficiency and safety, by providing supplementary or new funds for carrying on specific approved projects. It is the largest foundation active today in the field of traffic efficiency and safety.

E. C.I.T. Safety Foundation Program

The C.I.T. Safety Foundation, established in 1936 by the Commercial Investment Trust, gives its main stimulation to traffic safety activities by offering a series of annual awards to persons or organizations whose traffic safety activities are judged to be the best in several lines of endeavor. In addition, the Foundation inaugurated in 1937 an annual Seminar of Safety for newspaper men with a view to further development of traffic safety techniques which can be applied locally.

F. The Kemper Foundation

This Foundation's major activity is financing one-year fellowships for selected traffic officers and highway patrolmen at the Northwestern University Traffic Safety Institute.

G. The Alfred P. Sloan Traffic Awards

These awards, totaling $25,000, which have just been announced, have been created for the purpose of fostering progress in the safe and efficient use of streets and highways by: (a) encouraging states and cities in the use of scientific methods of traffic control and accident prevention; (b) emphasizing the importance of using men trained in traffic engineering and enforcement; (c) stimulating the training of men in these new and specialized professions; and (d) recognizing community achievement in traffic safety and efficiency by providing university training for their engineering and police personnel.

The awards will consist of twenty fellowships of $1,000 each plus tuition to provide a full year's academic training in the specialized fields of traffic control. The fellowships will be distributed between police officers and traffic engineers to attend the Northwestern University Traffic Safety Institute and the Harvard Bureau for Street Traffic Research respectively.

H. Project of A.P.W.A. Committee on Traffic Control

In 1937 your committee on traffic control adopted as its principal activity a project for promotion of the idea of having an engineer

already employed by a city, county, or state, designated to handle engineering matters in the traffic field. The project also included assistance to such men in better preparing themselves to deal with traffic problems from the engineering viewpoint. In line with this objective, the Association joined with the Harvard Bureau for Street Traffic Research by actively promoting attendance to the first short course Traffic Engineering Training School which was offered at Harvard University last August.

Announcements of the project were sent to 786 persons. Of these, 53 replied, 45 favorably. Sixteen persons indicated that specific action had been or was being taken. Of these, four indicated that an engineer was being designated to handle traffic matters. Thirteen wanted further information on what a traffic engineer would do, or as to what qualifications such an engineer should possess.

Of the 54 men who attended the short course Traffic Engineering School at Harvard, 13 attended definitely because of the A.P.W.A. project, and 14 others who attended were probably attracted in part by your Committee's project.

This project is to be a continuing one, and already further steps have been taken to advance its objective. Representatives of a number of other national organizations interested in traffic efficiency and safety have been requested to seek the cooperation of their local Safety Chairmen and members in promotion of this project. We are offering to serve as a clearing house for all such activities and reports of progress thereon. By means of this project it is hoped to accelerate a continuing scientific attack on traffic problems through traffic engineering in all communities over 50,000 population and in some communities somewhat smaller, which, because of their location, have a severe traffic problem. We are confident that means of improving the training of these engineers will keep pace reasonably well with increased interest of engineers in this profession.

I. Motion Picture Awards

For the first time in 1937 awards were made for best motion pictures dealing with traffic safety, both for regular theatrical films and institutional safety films. Selection of the winning films was made by the Motion Picture Traffic Safety Committee, consisting of prominent traffic specialists. For 1937 the feature picture, "The

Devil is Driving," by Columbia Pictures and the institutional film, "We Drivers," by General Motors Corporation, were awarded the prizes.

J. American Institute of Steel Construction Competition

In 1937 the American Institute of Steel Construction announced a design competition for an elevated highway in the hope that one of the immediate results would be to prove that highways of this type can be built economically and efficiently and still not be unsightly.

K. Additional Traffic and Highway Safety Activities

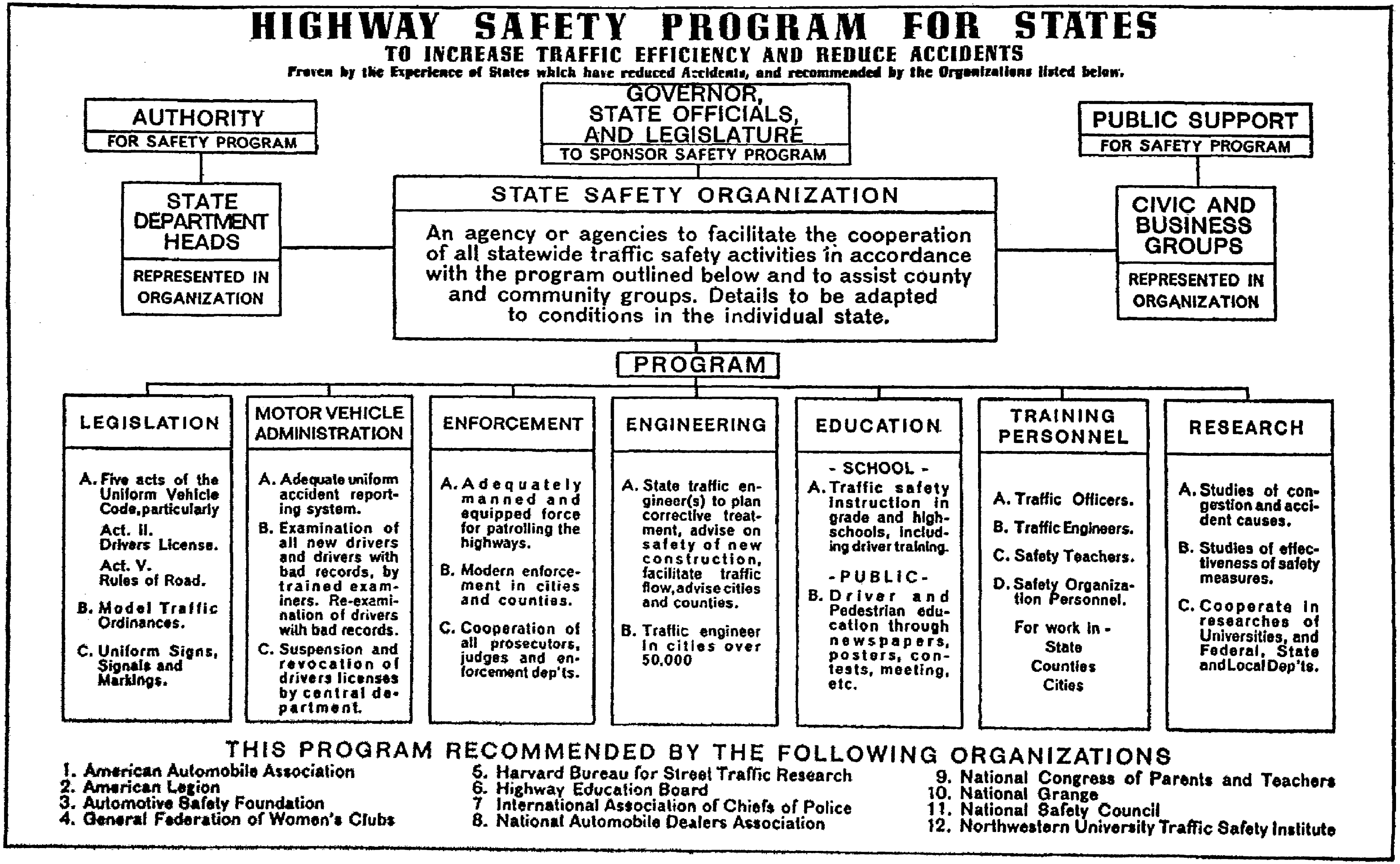
A number of other organizations provide stimulation for traffic safety activities within their own fields of endeavor. The American Trucking Association offers awards for best safety records made by fleets. The General Federation of Women's Clubs offers prizes for outstanding safety programs by local clubs. The American Automobile Association gives recognition to outstanding safety work among affiliated motor clubs.

Figure 1 (page 128) shows a safety program for states to increase traffic efficiency and reduce accidents, based on the experience of states which have reduced accidents. The program is recommended by twelve of the most active organizations in the field of traffic safety. By concentrating attention on the need of a suitable state safety organization and on most needed items under seven major headings, and by giving widespread distribution to this proposed program, it is believed that there will be effective stimulation of the outlined activities. The program indicates progress also in co-ordination of activities among the main interested groups.

Administrative Developments

A. Financial

1. *Federal Funds for Grade Crossing Elimination.* In the past few years federal funds have been made available for the elimination of railroad-highway grade crossings and considerable progress has been made. Under the N.R.A., 697 grade crossings were eliminated, and 706 were protected by automatic devices. The Emergency Relief Appropriation Act of 1935 provided $200,000,000 to be devoted to grade-crossing projects. A report from the U. S.



Courtesy American Automobile Association

FIGURE 1

Bureau of Public Roads as of June 30, 1937, showed that through these funds 1,152 grade crossings had been eliminated by separation of grades or relocation of the railroad or the highway, 698 additional eliminations were under construction, and 136 were planned for construction, making a total of 1,986. Protection by automatic devices had been or was being installed at 950 other grade crossings.

These programs reflect a new viewpoint concerning financing of railroad-highway grade-crossing elimination. It is that the public should assume a major share of the expense of such elimination, and it supersedes the policy which long delayed progress in this work, namely that of imposing upon the railroads a large part of the cost of improvement.

2. *Federal Aid for State Highway Planning Surveys.* As has already been mentioned, financial assistance is being furnished through federal aid for the conduct of such surveys.

3. *Federal Assistance in Traffic and Transportation Surveys.* As has already been mentioned, funds have been and are being made available through the federal government for the conduct of such surveys under the federal work relief program.

4. *State Assistance to Municipalities.* A number of states now have legislation providing for the use of certain proportions of state highway funds for the improvement of arterial routes within city limits. In some states these funds can be used by municipalities for traffic control and street lighting purposes on these thoroughfares.

B. Organizational

The following developments are all indications of the increasing realization on the part of governmental agencies of their responsibilities for increased traffic efficiency and safety.

1. *Resolution in Congress for Creation of Highway Traffic Safety Authority.* This resolution calls for an authority made up of representatives of the various bureaus in the federal government having active duties connected with traffic efficiency and safety and of representatives of the national organizations most actively interested in traffic conditions. It would act as a coordinating organization for logical federal activities in traffic and would help to stimulate state and local programs.

2. *Growth of Traffic Engineering.* As traffic problems have

grown more extensive and complicated, it has become increasingly evident that the only approach which will yield satisfactory results is to gather and analyze all pertinent facts, and base remedial measures upon the results of this procedure. This is the procedure of traffic engineering.

Since its inauguration in Pittsburgh and Seattle in 1924, traffic engineering has grown steadily until today more than 24,000,000 people live in cities where full-time traffic engineering work is being continually carried on. To date, about fifty municipalities have full-time traffic engineering service. During the past year, a number of cities have added traffic engineering service, including Cleveland, Toledo, New Orleans, Des Moines, Portland (Oregon), Tulsa, Dallas, Austin, Cincinnati, South Bend, Baltimore, Louisville, Richmond, and Wichita.

In addition, the following states have traffic engineering agencies, or the beginnings of such organizations: California, Connecticut, Colorado, Illinois, Indiana, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, Tennessee, Virginia, Wisconsin, and the District of Columbia.

3. *American Association of State Highway Officials.* In 1937 there was set up a Special Committee on Administrative Design Policies, a large part of the duty of which is to investigate major problems relating to highway design and affecting traffic efficiency and safety. As an example of its activities the Committee is investigating very thoroughly the question of adequacy of sight distances and appropriate standards therefor.

4. *Bureau of Motor Carriers, Interstate Commerce Commission.* This agency, which became very active in 1937, was set up to provide certain kinds of federal control of trucks and busses engaged in interstate commerce. Regulations have been issued pertaining to certain basic equipment which must be provided and maintained, providing regulations governing drivers engaged in interstate commerce, providing rules of the road for these drivers, and the establishment of a standard system of accident reporting for interstate commerce movements on the highway.

5. *Traffic Commissions.* In a number of states and municipalities, traffic commissions or traffic safety organizations have been set up in the recent past. The creation of such agencies marks a considerable advance toward improvement of traffic conditions. As an

example, in 1936 the legislature of New York state provided for a state traffic commission with state-wide jurisdiction. It was officially organized in September 1936. Since that time this Commission has ordered the establishment of speed zones, signs, traffic control signals, painted roadway markings, and other devices and measures for traffic improvement coming within its jurisdiction.

6. *American Association of Motor Vehicle Administrators.* This organization, made up of the motor vehicle administrators of various states, is very active in promotion of the Uniform Vehicle Code. It has a number of active committees, one of the most important of which is working on standardization of definitions, forms, and procedures relating to accident reports and their uses. One of the most significant developments is the increasing stress this organization is placing on the factual approach to administrative and traffic problems.

C. Developments Dealing with Operation

Mention has already been made of the state highway planning surveys. These are considered to be one of the most significant developments of recent years. They will furnish much more adequate information than has ever been available in the past as a basis for highway designs fitted to modern traffic needs, for sound and equitable financing of highways, the more logical development of highway systems, and so on.

The federal work relief programs have offered an opportunity for conducting traffic and transportation surveys on a scale never before possible. One hundred and thirty-two communities received approval of W.P.A. funds amounting to over $9,000,000 from July 1935 to January 1938. The largest single type in this group is the City Traffic Survey approved for 101 cities with W.P.A. funds totaling over $5,000,000. Next in magnitude is the assistance given in 21 state-wide highway planning surveys with nearly $3,000,000 of W.P.A. funds approved.

Sixty-five cities, two counties, and one state reported the culmination of surveys conducted under the W.P.A. program. Among those completed during 1937 are surveys in Detroit, San Francisco, Oakland, Columbus, Dallas, Seattle, and Atlantic City. Figure 2 (page 132) is a chart from the Detroit survey. It is based on the location of residence of drivers involved in accidents in Detroit. This analysis produced surprising and important information. It

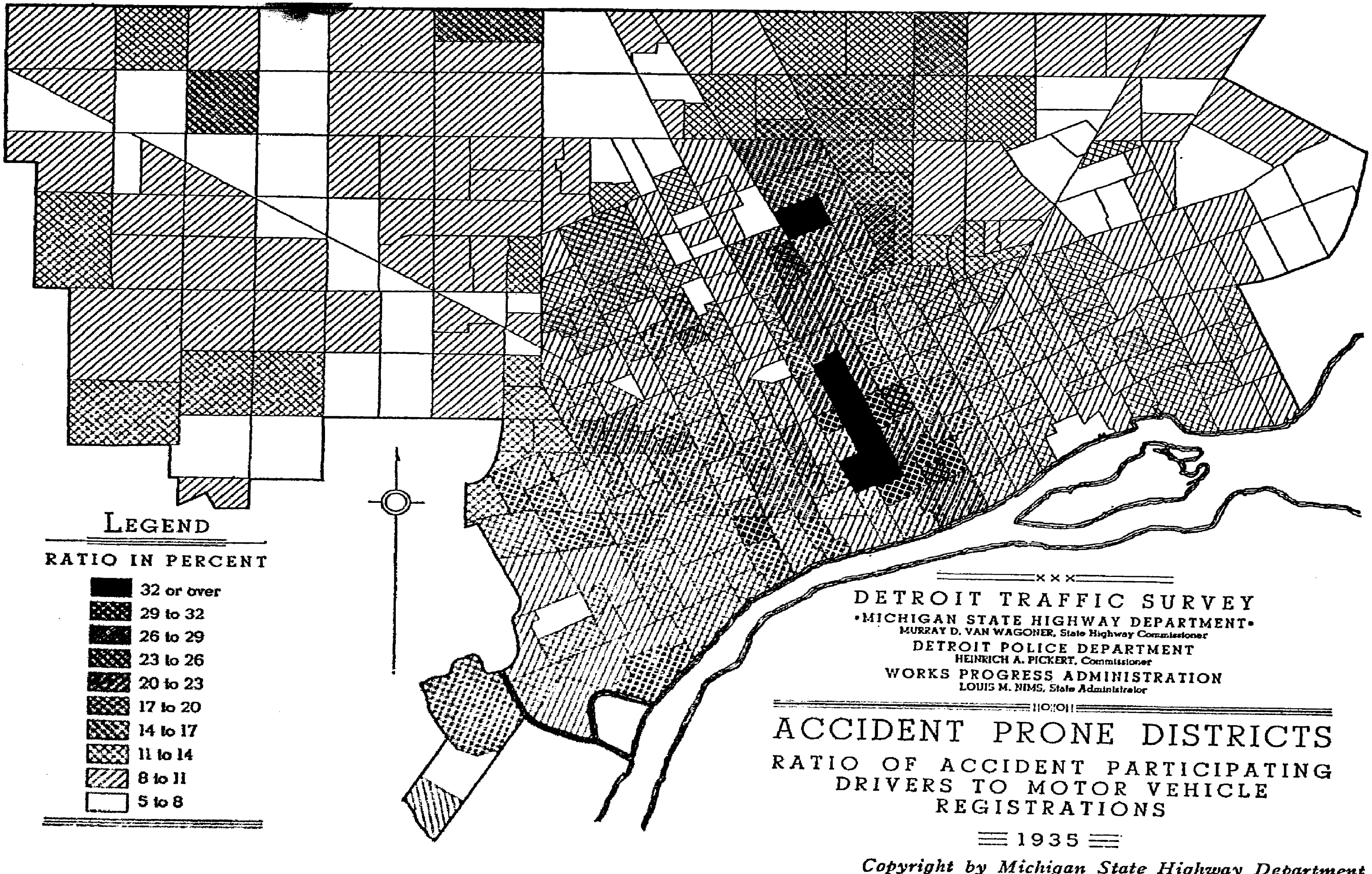

LEGEND
RATIO IN PERCENT
32 or over
29 to 32
26 to 29
23 to 26
20 to 23
17 to 20
14 to 17
11 to 14
8 to 11
5 to 8
DETROIT TRAFFIC SURVEY
•MICHIGAN STATE HIGHWAY DEPARTMENT•
MURRAY D. VAN WAGONER, State Highway Commissioner
DETROIT POLICE DEPARTMENT
HEINRICH A. PICKERT, Commissioner
WORKS PROGRESS ADMINISTRATION
LOUIS M. NIMS, State Administrator
ACCIDENT PRONE DISTRICTS
RATIO OF ACCIDENT PARTICIPATING
DRIVERS TO MOTOR VEHICLE
REGISTRATIONS
1935
Copyright by Michigan State Highway Department

FIGURE 2

showed that drivers residing in certain sections of the city, especially where groups reside who are not now being reached by traffic safety efforts in the English language, have had a very much worse than average record of accidents.

During the year 1937 the trend toward skilled and technical supervision was more pronounced, especially in the employment by communities of recognized traffic consultants. Twenty-four communities supplied the services of skilled traffic engineers. Practically all of the other surveys were approved to operate under the direction of city and highway engineers who seemed competent for such supervisory tasks. There were numerous outstanding accomplishments resulting from traffic surveys financed by work relief funds. Some of these are given later in this report.

D. Researches

1. *U. S. Bureau of Public Roads.* Under a Congressional authorization of $75,000, the U. S. Bureau of Public Roads with the co-operation of the Highway Research Board of the National Research Council, carried out in 1936 and 1937 a program of research projects covering accident-proneness of drivers, value of mechanical driver testing equipment, causes of serious accidents, accident reporting and investigation methods of states, and safety effects of maintenance systems used in motor vehicle fleets. The Bureau of Public Roads in its regular work has also given special attention to research on safety features of highway engineering.

2. *American Association of State Highway Officials.* Reference has already been made to the Special Committee on Administrative Design Policies and to the important studies which it is making.

3. *Highway Research Board.* This Board continues to carry on important researches dealing with highway design and development and with traffic efficiency and safety. Many of the researches which are reported on in Highway Research Board meetings are carried out by state highway departments and by interested colleges and universities.

4. *Additional Traffic Researches.* Mention has also been made that the Interstate Commerce Commission, through the safety section of its Bureau of Motor Carriers, is carrying on numerous studies. The American Association of Motor Vehicle Administrators is also carrying on studies in the fields of safety and administration.

Through their own program and with the assistance of grants from the Automotive Safety Foundation, important traffic research work is in progress by the American Automobile Association, the Harvard Bureau for Street Traffic Research, the National Safety Council, the Society of Automotive Engineers, and the International Association of Chiefs of Police. The National Conservation Bureau, Iowa State College, and other organizations are also conducting important traffic researches.

E. Personnel Training

One of the highlights of traffic progress within the past few years has been the tremendous increase in emphasis upon personnel training for persons specializing in various phases of a well-rounded traffic improvement program.

For a number of years certain progressive colleges and universities have been giving specialized training dealing with traffic control and highway design. The University of Michigan was one of the leaders. Other colleges and universities include Iowa State College, University of Illinois, Brooklyn Polytechnic Institute, and Harvard University.

Several years ago Northwestern University provided leadership in a new type of personnel training. This was training designed for police officers already employed, who were released from their regular duties to attend a two-week intensive course in a Traffic Officer's Training School. Through its Traffic Safety Institute, the university has continued this type of training and has extended it to provide training for highway patrol officers. This Institute and the Safety Division of the International Association of Chiefs of Police have promoted and conducted, or assisted in conducting, similar Traffic Officer's Training Schools in a number of other colleges and universities, including Pennsylvania State College, Harvard University, Rutgers University, University of Alabama, University of California, and University of Maryland. Most of these two-week training courses are held annually. They provide valuable specialized instruction for traffic officers and highway patrolmen.

The Northwestern University Traffic Safety Institute has within the past few years also conducted fellowship programs in which a one-year course is offered to police officers and highway patrolmen who qualify, with funds provided by the Kemper Foundation.

For a number of years the Harvard Bureau for Street Traffic

Research has conducted a fellowship program in which one year's specialized training is provided in traffic efficiency and safety for persons who qualify—more particularly in the last year or two, for engineers. Most of the graduates of this training program are now actively engaged in the field of traffic control. A group of fifteen research fellows and six students is now carrying on another one-year program, including four courses in traffic control, which they will complete next June.

With the cooperation of the American Public Works Association, the Automotive Safety Foundation, the American Automobile Association, the National Safety Council and the National Conservation Bureau, the Harvard Bureau for Street Traffic Research and the Institute of Traffic Engineers conducted a short "in-service" traffic engineering training program for the first time in 1937. Fifty-four men from various governmental and other agencies were enrolled and most of them satisfactorily completed the two-week training program. Eleven state departments concerned with traffic engineering problems sent representatives to this school, and in addition, twenty-three city or county departments sent men for instruction. Four of the men who attended were connected with federal agencies.

While not so directly related to the interest of engineers, it is rather significant to note that other training programs of importance are being carried out. Experienced educators with the American Automobile Association are carrying on in conjunction with state departments of public instruction, colleges and universities and city education departments, intensive one-week training courses for teachers designed to prepare them to teach traffic safety courses in high schools. To date, more than 700 teachers have been trained through these programs and through the summer session programs of the same general nature which have been conducted in twelve colleges and universities and four Indian Service Schools. In 1937 the National Safety Council also offered a special training program for safety workers.

Development of Traffic Control Devices and Methods

Within the past few years there have been significant developments in the design and construction of traffic control devices. The design of safety zones has been greatly improved and night accidents at permanent safety zones have been considerably re-

duced by effectively floodlighting the zone and by the addition of high and low lights so that the driver can know that he is approaching an obstacle, even if he is following another car.

There have been important improvements in traffic-actuated control equipment for use at intersections, school crossings, and so forth. Recognition is being given to the value of these devices in providing opportunities for pedestrians to secure an opportunity for safe crossing upon demand. This is especially significant in light of the fact that in cities about two-thirds of the fatalities involve pedestrians, and in light of the admitted need for giving greater attention to pedestrian protection.

Significant developments have been made in devices for automatically counting traffic and for determining the speed of traffic through mechanical-electrical means.

Guard-rail design has been very greatly improved. Considerable improvements have been made in methods of improving the night visibility of signs through better illumination, improved design of reflector button, and through other new features.

Development of Standards

Progress in 1937 in the development of standards relating to traffic was very encouraging. One example of special interest to engineers has been the development of the Manual for Uniform Traffic Control Devices. This includes standards for traffic signs, signals, markings, and islands. Copies of this Manual are available without charge to officials and interested engineers through the National Conference on Street and Highway Safety, Washington, D. C.

Standards for the making of particular types of traffic studies have been prepared by interested organizations. A traffic survey manual was prepared by the forerunners of the W.P.A. Advice concerning the making of traffic surveys can be obtained by writing to almost any of the interested organizations.

As before mentioned, the Committee on Uniform Traffic Accident Statistics became active in 1937 and is continuing its development work. Standards for sight distances are under study by the Special Committee on Administrative Design Policies of the American Association of State Highway Officials. Safety glass standards have been developed within the last few years, and are now available. The Bureau of Motor Carriers of the Interstate

Commerce Commission has set up certain standards affecting commercial vehicles.

Trends

There has been considerable gain in favor of the idea of speed-zoning in which varying prima facie speed limits are based on highway and traffic conditions for various sections of highways. It will be noted that this idea involves administrative determination of speed limits rather than legislative speed limits. Massachusetts, Rhode Island, and Connecticut are among the states which have given attention to this type of speed-zoning.

Another trend which seems to be gaining favor is the establishment of special speed limits for hours of dusk and darkness. For example, in Connecticut a rule has been adopted which provides that where speed limit zones in excess of forty miles per hour are effective during hours of daylight, a maximum speed limit of forty miles per hour shall be in effect during hours of darkness.

Development in Highway Design and Construction

In this field there has been a marked and very encouraging trend toward concentration on fitting design to modern traffic needs. Progress relating to the divided highway provides interesting evidence as to this trend. A divided highway is a highway separated into two one-way drives by a central non-traffic separator strip. An inquiry among state highway officials in about 1932 showed but little favor for this type of design. In 1937 a similar inquiry showed almost unanimous favor among the forty-one highway departments from which replies were obtained. In California, all roads requiring four lanes or more for adequate service for traffic will be developed into the divided type of roadway. Such a policy, proposed in 1936 by the American Automobile Association for all rural highways four lanes or more in width, is agreed upon as sound by many highway and traffic specialists and is gaining favor steadily. It is interesting to note that there are only about 1,200 miles of divided highways outside of municipalities in the United States today.

Other significant highway design trends which take account of modern traffic needs include cloverleaf grade separations, the provision of highway sidewalks where warranted, highway illumination designed primarily to reduce night accidents, the provision of

better sight distances on modern highways, the widening of traffic lanes to take account of higher speeds and the greater proportion of heavy and wide vehicles using our highways, considerable improvement in the non-skid quality of highway surfaces, the provision of wider and better shoulders, lane markings of highways, and the elimination of dips and narrow bridges.

On large proportions of our existing highway mileage, general or extensive modernization will probably not be undertaken in the near future because of lack of funds. In any case, however, there is needed an immediate, vigorous concentration of attention on the elimination or correction of the most serious hazard points on our highways. On many highways there exist serious hazard points, the correction of which would not involve very large sums of money. Fortunately, the Bureau of Public Roads and the State Highway Departments are taking steps toward a more scientific study of these hazards which will result in knowledge of the relative hazard per million vehicle miles. These studies will take time. In the meantime, some state money should certainly be set aside for correction of the worst existing hazards.

Freeways

Another very significant trend is toward the development of freeways where they are warranted. The essential idea of a freeway is well defined in brief terms in the Rhode Island Act now effective, which states as follows: "A freeway is a way especially designed for through traffic over which abutters have no easement or right of light, air, or access by reason of the fact that their property abuts upon such way." Freeway legislation was also enacted in 1937 in New York state. In these states the new statutes take the form of revisions to existing highway laws and apply only to state highways. This development for traffic facilitation is believed to be of fundamental significance.

The Tennessee Valley Authority has already constructed some miles of highway which embody this freeway idea, and also include an interesting provision. The abutting property owner relinquishes his right to access to enter the road in exchange for which he is given the right, with certain limitations, to cultivate public lands lying within the right-of-way of the route itself but not needed for highway purposes at the present time.

The express freeway, or limited way, is an extension of the free-

way idea. A report on the San Francisco traffic problem recommended a limited-way plan for that city including the following specifications:

1. A complete and continuous physical separation of opposed streams of traffic.

2. No direct access to abutting property and with all entries and exits to and from the structure by specially designed connections.

3. A continuous separation of all intersections with no cross movement of any kind across the operating lanes of the limited way.

4. A cross-section design to permit an adequate segregation of relatively fast and relatively slow vehicles and with retarding lanes at exits and accelerating lanes at entries.

Considerable progress toward the actual construction of express freeways or limited ways was made in Chicago, in that steps have been taken toward the financing of such a system for that city.

Construction Activities

Numerous major traffic structures were completed during 1937, a number of which have unique or new features. For example, the world's longest highway bridge was constructed over San Francisco Bay, joining San Francisco and Oakland with a four-lane undivided structure at a cost of approximately $77,000,000. The Golden Gate Bridge connecting San Francisco with the Coastal Highway to the north through the Redwood Empire, was completed at a cost of some $64,000,000. The span over the Golden Gate is the longest suspension span ever built.

Connecting the midpoint of Manhattan Island with New Jersey, one of two tubes of the Lincoln Tunnel has just recently been opened to traffic. The Lincoln Tunnel is part of a major plan to which further extensions will be developed later.

An additional major structure opened to traffic in 1937 was another link in the West Side Highway in Manhattan. This express highway is part of a major traffic system of the New York Metropolitan Area which will eventually provide connections from the Westchester Parkway System to the Lincoln and Holland Tunnels.

Parts of the Merritt Parkway System were opened to traffic in 1937. This parkway system contemplates connecting the Westchester Parkway System with New England through Connecticut.

The Attorney General of Oregon during 1937 prepared proposals for the consideration of the legislature whereby a superhighway system for Oregon would be created and would make possible speeds approximating those of the German Reich-Autobahnen.

During 1937 numerous parkway developments came into use. There was considerable extension to the Long Island system of parkways, particularly in connection with that portion of the system which will be utilized in connection with the World's Fair and as a connecting link with the Triborough Bridge.

The Blue Ridge Parkway, costing approximately $7,000,000, is under contract for grading, drainage, and bridge structures on 133 miles between the Shenandoah and the Great Smoky National Park. Access roads to the parkway will be limited and suitable grade separations will be provided at important highway and railroad crossings.

Funds were made available for the construction of a parkway, the Natchez Trace, from Nashville, Tennessee, to Natchez, Mississippi. Some of the grading and drainage work is under way.

Another important link in the outer drive at Chicago was completed and opened during 1937.

St. Louis has recently put into use an important highway link which provides for rapid, uninterrupted traffic flow for a considerable distance in an important section of that city.

Scientific Approach Produces Results

Throughout the country there are increasing evidences of excellent results obtained wherever the scientific approach has been impartially applied to the solution of traffic problems. The illustrations which follow relate mainly to traffic surveys financed by work relief funds:

1. *New York City*. Manhattan signal cycle reduced from 2 to 1½ minutes. Signal timing improved in other boroughs. Numerous signals timed for progressive movement. Six thousand signals installed at 3,000 intersections. Many changes made at hazardous intersections. Many changes in parking and other regulations adopted. Selective law enforcement placed in effect. Ordinance adopted preventing licensing of additional taxicabs. Many U-turns by cabs eliminated, cruising reduced, and more cab stands pro-

Accidents reduced 30 per cent since 1933 and economic loss prevented in cases where medical aid was requested is at least $13,000,000. Accident reductions at specific locations range between 30 and 80 per cent. Selective enforcement has resulted in 99.4 per cent convictions. The city was awarded the Grand Prize in the 1936 National Traffic Safety Contest. The survey performed a major role in the principal activities resulting in the award.

2. *Chicago Park District.* Ten pedestrian subways and one grade separation installed. Divisional fins, ramps, split drives, and other changes made at eighty-two intersections and along drives.

At twenty-four locations where recommendations were adopted, accidents were reduced 65 per cent.

3. *Minneapolis.* Seventy-nine corner-post type signal units installed at twenty intersections. Curb radii changes made at fifty-nine intersections, street widening at ten, safety islands at three. Sections of proposed by-pass loop widened and repaved. Street lighting budget increased 20 per cent. Nine hundred and twenty-nine lighting standards replaced.

4. *Baltimore.* Car tracks removed from a number of streets. New street through mid-town section. A number of streetcar routes changed or discontinued. New rush-hour loop for streetcars and new bus routes established. Many streetcar turning movements eliminated. Ordinances passed requiring stop signs to be illuminated or luminous at night, parallel parking, two-hour parking in central district, no parking near corners of safety zones, no parking at certain places during business hours and rush hours.

5. *Springfield, Mass.* Certain "through streets" established. One hundred and nineteen stop signs erected. Accidents on "through streets" reduced 43 per cent in 1936 as compared to 1934.

6. *Denver.* Quarterly vehicle inspections inaugurated. Intensive school child safety education program conducted. Traffic police personnel increased 30 per cent. Central business district congestion relieved by a new viaduct, several overpasses, and an underpass. Between twenty and thirty signals installed and several others removed.

7. *Macon.* Special course of instruction in accident reporting given to all police. Accident file by location, spot map and drivers' record file installed and maintained. Lane lines painted and maintained at all major intersections. Certain streets repaved. Parallel parking required along center parkway strips and generally out-

side the central business district. Signals installed at two intersections. Police assigned to arteries and intersections having most traffic. All one-way streets marked with signs. Car tracks removed or covered on some streets. Pedestrians required to cross at intersections or cross-walks under penalty for disobedience. Standard stop sign adopted. Some stop signs removed and many installed. Greater enforcement attention given to violations and violators causing accidents. Hand signaling for turns required. All violators responsible for accidents tried regardless of civil proceedings instituted. Five men added to motorized patrol. Special police details for private purposes discontinued. Parking prohibited in certain places. Many obstructions to view at hazardous intersections eliminated.

8. *Waterbury, Conn.* Accident investigation squad installed. All-night parking and parking on narrow and congested streets prohibited. Parking near intersections prohibited for a greater distance. All rotaries flood-lighted. Three intersections signalized. Walk lights installed at four intersections. Traffic lane lines painted at five intersections, stop lines at fourteen and center lines at four. All traffic signals retimed. Standard code for traffic devices adopted.

9. *Lawrence, Mass.* Education program carried out. School boy patrol established in every school. New playgrounds provided. A number of car tracks removed or covered. Obsolete and hazardous bridges replaced. Center lines painted at approaches to seven intersections, lane lines at three, curbs at four, cross-walks at all schools. Street lighting improved. Parking prohibited within thirty feet of approach to signals and signs.

10. *New Orleans.* Well-designed traffic circles of adequate capacity have been constructed at the ends of the approach ramps of the Huey P. Long Mississippi River Bridge, located approximately three miles upstream from the city limits. To provide an adequate highway connection between the bridge (East Bank end) and New Orleans proper, a new, four-lane, concrete highway of the divided lane type has been constructed at a cost of $90,000. An additional $27,000 is being spent for floral beautification of the parkway strip, particular attention being given to the planting of shrubs, etc. which will not obscure the vision of motorists, but which will nevertheless shield motorist's eyes from the glare of oncoming headlights.

An additional three and three-tenths miles of concrete highway of the divided lane type has been constructed at a cost of $110,000 to close one of the few remaining gaps on the Airline Highway which connects New Orleans with cities to the north and northwest. Sight distances are excellent, curves have been practically eliminated, and the highway has been equipped with road signs conforming to national standards.

Within the city proper, the two best examples of roadway construction are Pontchartrain Boulevard and Canal Boulevard. The former has been rebuilt from a narrow two-lane roadway to three lanes for "outbound" traffic and two lanes for "inbound" traffic. The "outbound" and "inbound" lanes are separated by a parkway strip ten feet wide. Canal Boulevard is also of the divided lane type; two lanes for moving vehicles and one lane for parked vehicles on each side of the parkway strip.

Problems Requiring Immediate Attention

With continuing application of the scientific approach, certain aspects of the traffic problem are being brought into focus as demanding special emphasis and attention. An illustration is provided by Figure 3, (page 144) indicating that young drivers are making a very much worse record as to fatalities in terms of miles driven than are older drivers. This graph is based on a study made by Dr. H. F. Johnson for the Highway Research Board and the U. S. Bureau of Public Roads, and on data obtained in the American Automobile Association's driver testing studies. It emphasizes the importance of directing major attention to improvement in the driving records of young drivers.

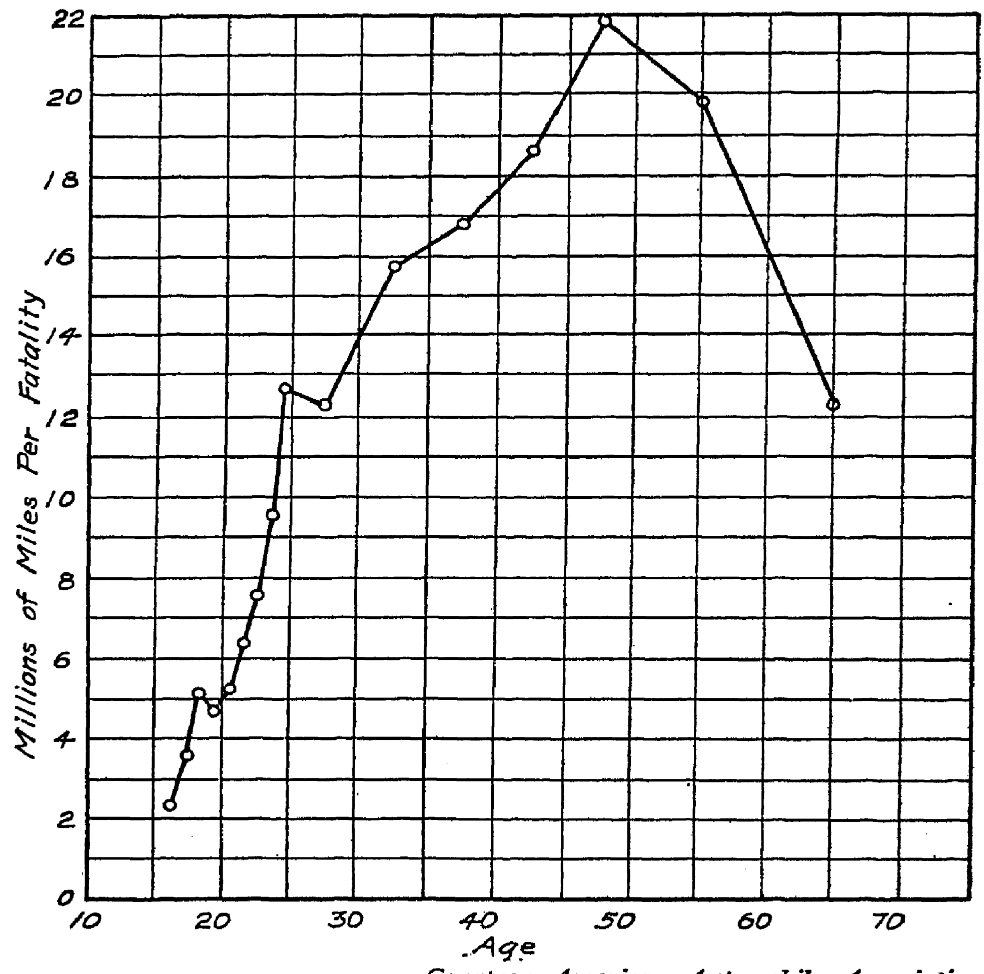
A. Night Accidents

In the past few years, the seriousness of the night accident situation has increased to a degree warranting special attention. In this connection, it is significant to note that in the year 1937 there was progress toward considerable improvement in headlighting units on motor vehicles, looking toward a standardized system.

Studies of highway illumination continue, as do technical developments in highway lighting units and plans for mounting those units. Progress which has been made leads to the hope that there will be further impartial research in the near future as to the

effects of highway illumination. This study would include not only effects on night accidents, but also the effects on driving speeds, increases or decreases in traffic volume, effects on drivers, etc.

For the immediate future, the great need in reducing night accidents is for better education of drivers and pedestrians. Particular attention is necessary as far as pedestrians are concerned, in that they do not realize the extent of hazards at night. They fail to realize how difficult it is for the driver to see them, when they can see the headlights so easily. Many of them do not carry a light



Courtesy American Automobile Association

FIGURE 3. FATALITY HAZARD MUCH GREATER FOR YOUNG DRIVERS

Chart showing approximate mileages driven per fatality for drivers of various age groups. Mileage data for various age groups from A.A.A. driver testing records. Numbers of drivers of different age groups involved in fatal accidents per 100,000 of that age group registered, from Connecticut data in paper, "Selection of Accident-Prone Drivers," by H. M. Johnson, presented at 1937 meeting of Highway Research Board, Washington, D. C.

or even wear or carry something white, or something which will reflect light.

B. Pedestrians

Recent studies have indicated how important it is that special attention be given to pedestrian accidents. In cities, about two-thirds of traffic fatalities involve pedestrians. Even in rural territory, about one-third of traffic fatalities involve pedestrians. Studies made by the American Automobile Association and others indicate that aged pedestrians are involved particularly frequently in serious and fatal accidents, and that they are most frequently hit in hours of dusk and darkness. *The facts demand that major attention be given in the future to methods of reducing pedestrian hazards, and of educating pedestrians so that they will avoid hazardous practices.* During 1937 the American Automobile Association developed, almost to completion, a Pedestrian Aids Manual designed to focus attention on this problem and to indicate correctives which can be applied. The National Safety Council also has studies in progress on this subject, as do other organizations which are interested.

C. Parking and Terminal Facilities

Little change was witnessed in 1937 in so far as the parking problem is concerned. Parking meters have been used in a number of communities with varying degrees of success. A decision was made in 1937 by the American Automobile Association to set up a national committee of leading specialists in the various aspects of this problem, to develop a comprehensive report in the months ahead.

Lighting and Public Safety

Paul H. Goodell

Cincinnati, O.

Chairman of and Reporting for the Committee on Lighting and Public Safety *

In studying the problem of the increasing number of traffic accidents and the methods of correction which are undergoing trial throughout the country, it is the opinion of this Committee that coordination of public works activities to determine and apply the necessary corrective measures can produce substantial results in the nation's war on traffic accidents. It is true that most public works departments are aiding in this fight, either directly or indirectly. However, in a great majority of cases, conditions resulting from economic pressure have increased the duties and responsibilities of curtailed departments to such an extent that traffic safety, of which little was heard until the boom days of 1929 when we were all too busy to give it any attention, has grown up, a rebellious orphan in need of corrective guidance and properly coordinated supervision.

It is not at all the exception to find accident records kept by the police department but never put in a form that is actually usable by the planning commission; for traffic signals to be installed by some other department entirely on the basis of popular demand; for safety zones to be located wherever the maximum number of transportation lines converge, and for street lighting to be apportioned in accord with the willingness of property owners to meet assessments. By comparison, a sales manager in private enterprise will carefully weigh the relationship, and consequent budget appropriation, between advertising, window displays, direct mail promotion, catalogs, and traveling salesmen. The administration of safety is in need of similarly balanced coordination to bring together the facts and determine why 40,000 lives should be lost

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*Committee on Lighting and Public Safety, 1937

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in accidents throughout the nation in a single year, with substantially no means for improvement yet in sight.

While it may be largely true that the degree of safety depends upon public education and enforcement, the first requisite of motor vehicle transportation on which we are placing the responsibility for accidents is a public thoroughfare on which to travel. This thoroughfare, its planning, construction, and maintenance, is a public works function forming the fundamental basis for all traffic safety. It therefore seems logical that the coordination of safety administration should, in no small degree, become a function of public works.

Where public works departments do not include provisions for traffic engineering, such facilities should properly be considered. Accident records obtained from enforcement authorities should, through proper interpretation, become an all-important factor in city planning, determination of the facilities for traffic control, street lighting, and many of the other important functions of public works.

Detroit Utilizes Experience

To demonstrate how traffic accident experience can thus be utilized, through properly coordinated administrative efforts, to achieve a higher degree of safety, the experience of the city of Detroit can be cited. Upon an analysis of its accident records, it was found that for a period of approximately thirty-four months from the beginning of 1934 until the latter part of 1936, thirty-one miles of its main thoroughfares showed an accident experience of one hundred forty-six fatalities during the night hours and twenty-one fatalities in the daytime, a ratio of seven to one. In many cities these accidents might have been charged up to speed, drunken driving, pedestrian carelessness, fatigue, or many of the other causes which often command public attention but which share less major responsibility for accidents than we are frequently led to believe. No doubt many of these factors were present in the fatal accidents in Detroit, but the degree of their importance was questioned by the officials since there was no reason why such conditions should vary greatly between the hours of daylight and darkness.

The conclusion was accordingly reached that improved street lighting for modern traffic conditions should be provided. In the

period of from nine to thirteen months since the installations have been completed on the various streets, the merits of this remedy have been demonstrated. Only fourteen fatalities have occurred at night and ten during the associated hours of daylight, giving a ratio of less than one and one-half to one. On one particular section of Grand River Boulevard, one and three-fourths miles in length, there had been thirteen fatalities at night and none during the daytime. After fourteen months' experience under improved lighting there has been but one fatality at night and one in the daytime.

To those municipal officials interested in lighting as a remedy for their traffic accidents, it will be of interest to know that in both the old and the improved lighting installations the same size lamps were used (10,000 lumens) and the spacing remained the same. The improvement consisted in the use of a new and more efficient type of equipment at 22-foot mounting height instead of 18 feet as had formerly been employed. However, the average horizontal foot candles were increased from 0.32 to 1.12. The result in saving of life and property damage speaks for itself.

Such tangible evidence, substantiated by that of other cities, reveals that accident experience can be improved by carefully determining needed remedies and putting them into effect. The degree of safety of public thoroughfares is primarily dependent upon such features as the physical characteristics of intersections, traffic islands, safety zones, pavement surfaces, and street lighting. These are the responsibility of a public works department.

This Committee recommends that public works administrators direct the maximum attention possible to public safety, with a view of organizing the functions of their departments to adequately determine and most effectively combat the contributing causes of accidents within their authorized jurisdiction. It further recommends that the American Public Works Association give consideration to lending such guidance as can be provided within the scope of its activities.

Airport Runway Stabilization

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Reporting for the Committee on Airports and Landing Fields *

THE INCREASING size and landing speeds of some of the airplanes in commercial service make a corresponding improvement in the airport surface imperative if these larger and faster airplanes are to be adequately served.

The financial ability of the community does not always keep pace with its desire to provide landing facilities that will serve the most recent of these demands and thus attract and hold the maximum of air transportation.

Economy and commercial ambition seem thus to be at odds. A new application of an old social idea and a new interest in an old engineering problem combine their forces to reconcile these opposing interests and accomplish improvement with economy while effecting social gains and advancing the sciences.

The need for economical improvement of airport surfaces has been met by Works Progress Administration projects and by the adaptation of soils mechanics in the stabilization of landing areas.

Work on airport projects generally lends itself well to the proper utilization of the labor made available through the W.P.A. program. This labor can be particularly well used in stabilization of soils because such work can often be so planned as to call for comparatively little expenditure besides the labor and the equipment required to use it economically, which latter is often immediately available in the city plant.

A stabilized surface is one in which the resistance to the displacement of component particles has been increased by selection and proportioning of grain sizes; by the control of moisture content during construction and afterward; and in some instances by the addition of a minimum amount of cementing or binding material.

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*COMMITTEE ON AIRPORTS AND LANDING FIELDS, 1937

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Stabilization an Engineering Job

The proper application of the science of soils to the stabilization of airport surfaces is an engineering job. The solution of such an engineering problem should be made only on the basis of careful analysis of the requirements to be met and of the means at hand for meeting them. The experience in other fields and of other times should be drawn upon to guide the development in this new use.

As is often the case when anything is brought forth in a new dress, there are many who are quick to profit by the public attention which is temporarily drawn. So we have bogus experts offering to stabilize the soils for any purpose, whether earth dam, foundation, road, or runway, and they would have you think they can do it with some nostrum which they have to sell, at a profit, to be sure, for themselves. There is so much misinformation currently being put out about soils mechanics that for many the whole subject is clouded with doubt and distrust. It must be remembered, too, that people have been improving, or stabilizing, roads on a kind of guess work or "practical" basis for years, although the technical development of stabilized roads has been pronounced only in recent years. These facts make it all the more important that careful attention be given to finding out just what is of real worth in this connection.

Although the principles involved in soil stabilization are not new, the science of soils mechanics as a rational approach to the use of soil as an engineering material is only ten years old. It is developing rapidly and as yet many of its procedures are indefinitely defined. It is to be expected that exactness is out of the question in dealing with such a variable as soil, which affords no two samples exactly alike and for which, though actually non-existent, homogeneity must be assumed. It is also to be expected that because of the long history of practical experience in road construction, there is bound to be a resistance to the rapid introduction of an untried theory. It would be interesting to follow through the manner in which stabilization came into prominence in connection with this class of work. Although not recognized, the engineering principles have been back of the practical successes. This unwitting combination is probably as old as the need for a dependable traveled way. It must be as old as the use of vehicles as an evidence and an accompaniment of civilization.

Moisture and Consistency Vital Factors

Some roads have been dry weather roads, some have been good only when wet. Thus the effect of the moisture content is simply stated. The natural surfaces of sand, clay, loam, and other material show different properties alone, in combination, and when carrying different amounts of moisture. For example, the firmness of wet sand is clearly illustrated in the case of the speedway at Daytona Beach, Florida. Even the youngster bathing by the seashore learns something about stabilization as soon as he realizes the difference in resisting properties of the sand upon which he treads according to the amount of water which it contains.

Again, the surface tension of moisture contained in the mass has great importance in building up resistance in sand surfaces. Even the casual observer notes that clay has characteristics just the opposite to those of sand. Its greatest resistance to displacement occurs when it is dry, and its resistance is destroyed when it is saturated throughout.

The balancing of these features, one against the other, was probably one of the first lessons in stabilization. The resistance to displacement depends not only on moisture but that in turn depends on the sizes of particles and the spaces between them. This physical characteristic depends, particularly in the case of sand and larger particles, on the size and gradations required to build up the interlocking properties.

Preparation of Subgrade

Subsequent to the early methods of road surface stabilization with sand, clay, gravel, and broken stone, and when higher types of pavement came generally into use, it was found that considerable care should be given to the preparation of the subgrade to prevent failures in the pavement. It was early appreciated that the provision of proper contour, cross section, and firmness in the subgrading permitted more expeditious placing of the pavement slab, and by virtue of uniformity, would be economical as well, in reducing the quantities of materials required in the finished pavement. Much difficulty was found, however, in rolling certain kinds of subgrade soils. Clay seemed to offer no end of trouble to the vehicles transporting pavement materials.

One of the earlier schemes developed to improve subgrade prop-

erties was the placing of the so-called "blanket course" of such granular materials as sand, pulverized shells, cinders, or combinations thereof over the subgrade natural surface. The required thickness of this blanket course approximated the maximum dimension of the material used for the stone surfacing. Later considerations indicated that a better job could be obtained by working the granular material with discs, harrow, or blades into the natural surface, and would permit of rolling, which was not always practicable with the blanket surface alone. It is at this point, I am inclined to believe, that the extensive use of the word "stabilization" appears. Results from such types of treatment had proved so satisfactory that the term stabilization began to be applied to similar methods of treatment for finished surfaces. However, the dust problem nearly always accompanies roads not treated with bituminous materials and is only partially mitigated by the use of such deliquescent chemicals as calcium chloride. Sooner or later the finished roadway surface had to be designed to actually eliminate the dust problem.

Attempts to Cut Costs

The great demand for highways made increasing experimentation necessary for types of construction to reduce costs of finished work. The high type pavement of concrete, brick, and plant-mixed asphalt could not be afforded for the great amount of mileage needed. In the first stages of developing lower cost or medium cost roadway and runway surfaces, some futile work was done in using light oils having very low viscosity when cold. The use of hot road oils for mixed-in-place work was subject to the limitations of time in which the operation should be performed before the oil would cool to such point that its viscosity prevented proper working. In this stage, however, the use of penetration macadam surfaces made great headway.

In the next stage of mass production of the mixed-in-place stabilized surface, the development of bituminous materials that could be applied cold was the natural consequence of the time limitations set on operations in the use of hot materials. Cut-back asphalts and tars in which materials of proper viscosity were blended with naphtha gave admirable results. Time was no particular concern as the viscosity could be fairly well controlled by the amount and type of naphtha used as a blending agent.

However, the art of stabilization with bituminous materials still suffered the disadvantages induced by rainy weather. Rain not only slowed down the work but would often spoil quantities of it and increase its cost. In overcoming this weather problem, the final stage in the evolutionary processes for developing suitable bituminous materials appears. That is the use of asphalt emulsion in which the time element is taken care of by the mixture of water and an emulsifying agent with the bitumen. The development of this material was almost sufficient grounds for the roadway designer to shout "eureka." Rain or cold would not affect it. As a matter of fact, wetting of the surface to be treated was a necessity and, if it did not rain, the surface had to be sprinkled before the emulsion was applied. The time elapsing between the actual application of the material and the beginning of the setting action, which is known as the "breaking time," is subject to control in manufacture, and emulsions have been graded according to the breaking time required.

As the use of such cold bituminous materials progressed, the equipment for placing them and mixing with the surface material aggregates was also improved. The mixing with a disc and tooth harrow followed by blading back and forth gave remarkable results in reducing the amount of labor required for road construction compared with earlier processes. Even this scheme has been improved upon by the use of the so-called retreading machine. This is no more nor less than a combination drag and blade which turns the aggregate and bituminous mixture back and forth four or five times in a single passage of the device.

I do not believe that the use of the term stabilization originally had particular reference to the use of bituminous or chemical materials in treating the surfaces. Nevertheless because of the most recent successful developments, it is not uncommon to hear it used now with no particular reference to any other methods. I think we should preserve the general meaning because of the possibilities which the future holds in the rapid development of the technology of soils mechanics.

Experience with Bituminous Stabilization

Since bituminous stabilization has been used in the construction of a number of airport runways, some further consideration is warranted. This method has a higher ratio of material cost to

labor cost than is ordinarily carried out in highway construction. Equipment costs are about the same. These features must be taken into consideration in planning a W.P.A. project because not only must the cost of the surface be considered but also the cost of employing the men. In other words, the cost for items other than labor must be kept at a minimum if they are to be paid from federal funds.

It often happens that a considerable variation is found in that the relative quantity of bitumen required for stabilizing the same area is greater than in other types of bituminous surfacing. This is particularly noticeable in airport runway construction where the physical properties of the finished surface are intended to be of a different nature than for vehicular roadways. In airport runway construction flexibility is an important feature. To obtain this flexibility a surplus of bitumen in comparison with highway practice is needed, and further, it is believed that a lower viscosity of the unemulsified bitumen is desired. The marring of the surface of a runway is easily remedied. While not like so much putty, the finished surface is made far more pliable, plastic, or workable than the stabilized surface of a highway. Therefore, the scoring of the runway by the tail skid of a plane, or damage from any other source can be readily rectified by immediate blading and rolling, or with hand tools, often without need of any additional material. This maintenance cost must, however, be taken into consideration in making the selection of the type of runway surface to be built.

Oakland Municipal Airport

An illustration of runway stabilization for damp and yielding subgrade is furnished by the Oakland Municipal Airport at Oakland, California.

This airport is famous as the take-off for many trans-Pacific flights and is the second largest airport in the United States. The subgrade of flue mud and peat is reclaimed tide land. The airport surface is five feet above sea level and the ground water level is eighteen inches below the surface. It was thought that moisture might be prevented to a large extent from being drawn by capillary action to the runway surface if the base were stabilized with emulsified asphalt.

In the construction of the main east-west runway 200 feet wide by 2,000 feet long, the aggregate consisted of a mixture of dredged

gravel and red rock. The proportions used were as follows: 8 cubic feet red rock, 4 cubic feet gravel, 6 gallons stabilizer, with water to suit.

Existing material was loosened and graded, then dampened and with water and stabilizer mixed in place at the rate of .81 gallons per square yard. This first two inches was then raked to a uniform surface grade and allowed to dry, but not rolled. After two or three days this first layer was then topped with from two to three inches of the premixed stabilized slurry base. In about two days, an eight-ton tandem roller was used to give first a preliminary rolling and a day or two later this was followed by a more concentrated rolling.

When premixed material was used for the first course, the subgrade was built up and rolled before placing the stabilized base material.

The use of emulsified asphalt stabilization in cold weather is found in the construction of surfacing for runways at the municipal airport at Matamoras, Pennsylvania. An area of 42,500 square yards three-fourths inch thick was started on November 4, 1936, and the work was carried forward during periods when the temperature ranged between 35 and 40 degrees. Despite the adverse weather conditions an excellent surface was secured by this method.

Davis Island Airport at Tampa, Florida, has runways of stabilized sand. The bituminous material called for by the specifications was petroleum tar with a cut-back asphalt seal coat.

Conclusion

Thus we find some new and interesting combinations of fields of study that enter into the problem when a municipality wishes to practice economy and keep pace with the latest progress in aviation.

In the engineering study, soil is taken to comprise that part of the earth's crust which is not occupied by water or rock, and is in turn divided into classifications according to size of the component particles. Methods of defining and determining various characteristics have been devised. The void ratio, porosity, moisture content, grain sizes, density, plasticity, permeability, and other features must be known and expressed in technically understandable terms just as we must know the weight, tensile strength, compressive strength, elastic limit, shear, and other characteristics of steel before we can properly design a skyscraper.

Laboratory techniques, which have developed satisfactory results,

must be translated into good construction practice before stabilization can be taken out of the rule of thumb, haphazard way of doing things and put into the engineering category of dependable construction work.

When this has been done and the actual operation has been adapted to the employment needs of those who otherwise would be unemployed, then it can be truly said that engineering has joined forces with social service to provide with economy safe harbors for the airplane, a forward step for the engineer, and a chance for some worthy person to earn a decent living.

Flood Control, Irrigation, and Drainage[1]

ABEL WOLMAN

Chairman, Water Resources Committee

TWO ACTS of the 74th Congress greatly extended federal responsibility in the field of flood control, and established a national flood-control policy with the federal government as the directing authority. Recognition was given to the primary principle of securing collateral benefits from the waters in a flood-control project, and to the principle of local participation in costs. Congressional approval was given, in both the Flood Control Act and the Act amending the flood-control program for the Lower Mississippi, to reservoirs and other means of retarding run-off from headwaters as flood-control works. The 1937 Amendment to the 1936 Flood Control Act gives the Secretary of Agriculture authority to require compliance with certain conditions in order that benefits to be derived from measures for water-flow retardation and soil-erosion control may be extended to lands not owned or controlled by the United States.

The Overton Act[2], amending the Flood Control Act of 1928, authorized reservoirs for the first time as elements in the flood-

[1] Based largely on the Report of the National Water Resources Committee on "Drainage Basin Problems and Programs—1937 Revision."

[2] Public Law No. 678, 74th Congress, approved June 15, 1936.

control plan for the Lower Mississippi. The Act requires states or other qualified agencies to provide all necessary lands, easements, and rights-of-way without cost to the United States; to hold and save the United States free from damages due to construction; to maintain and operate the completed works according to regulations prescribed by the Secretary of War; and to make the necessary alterations of highways and to assume all damages due to such alterations. It provides for purchase by the United States of flowage rights in the Eudora, Morganza, and West Atchafalaya floodways; provides for federal construction of a limited number of railways and highway crossings over these floodways; and provides for federal responsibility for drainage necessitated by floodway levees.

The Flood Control Act of 1936[3] has special national significance in that it declares flood control on navigable waters or their tributaries to be a proper activity of the federal government in cooperation with states. It places federal investigation and improvement of rivers and other waterways for flood control and allied purposes under the jurisdiction of the War Department, and federal investigations of watersheds and measures for water-flow retardation and soil erosion control under the jurisdiction of the Department of Agriculture. It specifies, however, that these grants of authority shall not interfere with investigations and river improvements incident to reclamation projects undertaken by the Bureau of Reclamation under any general or specific authorization law. It requires states or subdivisions thereof to assure provision without cost to the United States of necessary land easements and rights-of-way, authorizes any two or more states to enter into compacts or agreements for the purpose of carrying out provisions of the Act, and authorizes construction of specific flood-control projects (including reservoirs) and investigations of other specified projects.

The Flood Control Act of 1936 was amended in 1937[4]. Under this amendment, the Secretary of Agriculture may require compliance with the following conditions in extending any benefits in the prosecution of measures for water-flow retardation and soil-erosion control to lands not owned or controlled by the federal government.

1. The enactment and enforcement of state and local laws imposing suitable restrictions on the use of such lands and otherwise

[3] Public Law No. 738, 74th Congress, approved June 22, 1936.
[4] Public Law No. 406, 75th Congress, approved August 28, 1937.

providing for water-flow retardation and the control of soil erosion.

2. Agreements or covenants as to the use of such lands; and

3. Contributions in money, services, materials, or otherwise, to any operations conferring such benefits.

Section 5 of the 1937 Amendment of the 1936 Flood Control Act authorizes the Secretary of War to make preliminary examinations and surveys for flood control at 114 localities, and further authorizes the Secretary of Agriculture to make preliminary examinations and surveys for water-flow retardations and soil-erosion control on the watersheds of such localities.

Interstate compacts for flood control in the Connecticut and Merrimack valleys were approved by the legislatures of the states involved. New Hampshire and Massachusetts negotiated an agreement relating to the Merrimack River, and Vermont, New Hampshire, Massachusetts, and Connecticut participated in one providing for flood control in the Connecticut Valley. These agreements were ratified at the legislative sessions of the states in 1937 and were submitted to the Congress, but they have not yet been approved.

During 1936-1937, the states of Arkansas, Idaho, Illinois, Louisiana, New York, Pennsylvania, Mississippi, and Washington either created special commissions or designated some state agency with authority and power to make studies, surveys and plans, and to carry out necessary measures for flood control and protection on the rivers of the state. Most of these states are empowered by their legislatures to cooperate with the federal government on flood-control projects. Arkansas and Pennsylvania are authorized by their legislatures to enter into compacts with other states. Idaho, Mississippi, and Washington laws provide for the creation, operation, and maintenance of flood-control districts.

State legislation for the creation, maintenance, and operation of levee and flood-control districts, the acquisition of property and the construction of flood-control works, and for surveys and investigations by state agencies was placed on the statute books of Louisiana, Maryland, Massachusetts, New Hampshire, Pennsylvania, and Texas.

New Flood-control Projects

Some of the major projects which are now under construction or which are ready to be placed under construction are discussed in the following paragraphs.

Merrimack River Basin. The projects under immediate consideration in the Merrimack Basin are the Franklin Falls and Blackwater reservoirs. In addition to these reservoirs, some of the larger communities will be protected by flood walls and channel improvements. The design for one reservoir project is practically complete, and preliminary investigations are being conducted preparatory to design of the second. Construction is delayed by the fact that interstate compacts required by the Flood Control Act for 1936 have not been ratified.

Connecticut River Basin. Flood-control projects on the Connecticut River involve reservoirs which will reduce flood heights and also flood walls for additional protection of certain communities. The reservoirs and protection works are being designed. Preliminary work and subsurface investigations are under way. As with the Merrimack River, construction has not been undertaken.

Ohio River Basin. Tygart Dam on the Tygart River near Grafton, West Virginia, was begun in 1934. It is scheduled for completion during the spring or summer of 1938. It is of the concrete gravity type, 215 feet high, 1,850 feet long, and will create a reservoir with a capacity of 314,000 acre feet. The reservoir will be operated for the benefit of flood control and navigation. Of the total storage, 314,000 acre feet will be available for accommodation of spring floods, and 214,000 acre feet for accommodation of summer floods. The difference of 100,000 acre feet will be devoted annually to navigation storage to augment the low-water flow of the Monongahela. Incidental benefits to domestic and industrial water users will result from the increased low-water flow made possible by this reservoir.

At the first of each calendar year, the reservoir will be practically empty. From that time until about April 1, it will be operated solely for control of floods. Thereafter, water will be allowed to accumulate until the navigation storage pool level is reached about July 1. From then until about December 15, the accumulated storage will be gradually released to augment low-water flows in the Monongahela River. Flood water that fills the reservoir above the storage level prescribed for that time of the year will be discharged as rapidly as it can be without contributing to a harmful stage in the Monongahela River.

Susquehanna River Basin. Arkport Dam is situated on the Canisteo River about one-half mile west of Arkport, New York. The dam will be of the earth-fill type, 112 feet high and 1,205 feet long.

The reservoir will have an area of 191 acres, a capacity of 8,000 acre feet, and will be operated as a flood-control reservoir only. The Arkport reservoir is one of a series of projects for the control of floods along the Susquehanna River.

Whitney Point Dam is on the Otselic River about 24 miles above Binghamton, New York. It will be of the earth-fill type, about 80 feet high, and will control the run-off from an area of 250 square miles. The reservoir will have a capacity of about 87,000 acre feet at spillway crest. The project is one of a series of reservoirs on the tributaries of the Susquehanna River for the control of floods.

The Kingston-Edwardsville Project, in Pennsylvania, involves approximately 1,600 linear feet of earth-fill levee, 3,500 linear feet of earth-fill reinforcement to existing dike, 5,400 linear feet of pressure culvert, and other miscellaneous control works, including five flood gates, three temporary bulkheads, intercepting sewers, insulation of pumping units, and railroad and highway relocations. The work is under way with emergency relief funds.

The Wilkes-Barre and Hanover Township Project in Pennsylvania involves about 20,000 linear feet of earth-fill levees and 3,100 linear feet of steel sheet piling wall, including 5,400 linear feet of pressure culvert, intercepting sewers, appropriate pumping units, and temporary bulkheads. The work is under way with emergency relief funds.

Arkansas River Basin. Conchas Reservoir is on the South Canadian River about twenty-five miles north of Newkirk, New Mexico. Construction of the project, begun in 1935, is scheduled for completion during 1939. It provides for a reservoir to be operated primarily for flood control and irrigation. The main dam will be of a concrete gravity type, 220 feet high and 1,250 feet long with earth dike at the end, having an over-all length of about 4 miles. The reservoir will have a capacity of approximately 600,000 acre feet and in addition to its flood-control storage will provide an annual supply of 140,000 acre feet of water for irrigation. Construction of Conchas dam will reduce all except extreme floods to a discharge of approximately 75,000 cubic feet per second, which can be safely carried in the river channel; it will also materially reduce the peak of extreme floods. The reservoir will form an integral part of the program for flood control of the upper Arkansas River. Water supply outlets will be provided in the dam to enable Tucumcari and Amarillo to obtain adequate future domestic water

supplies if later conditions justify completion of the water supply systems.

It is planned to operate the reservoir so that irrigation storage will extend from the irrigation outlet to the crest of the main dam spillway. Irrigation water will be withdrawn as needed. Flood control storage will extend from the main spillway upward to the emergency spillway and will be discharged through an uncontrolled spillway in the main dam. Above the crest of the emergency spillway flood water will discharge through both emergency spillway and main-dam spillway.

Fort Supply Reservoir is on Wolf Creek, a tributary of the North Canadian River, about ten miles northwest of Woodward, Oklahoma. The reservoir will have a primary purpose of controlling floods on the North Canadian River but in addition will provide an ample domestic water supply for Oklahoma City. The reservoir will form an integral part of the program for flood control on the Arkansas River. Local interests will pay the estimated cost of the combined development for flood control and water supply in excess of the cost of the development for flood control only.

The dam will be of earth, 82 feet in height and approximately 10,500 feet long, with concrete spillway. It will impound 202,000 acre feet of water, of which 90,000 acre feet will be available for domestic water supply storage.

Santa Ana River Basin. The Prado retarding dam, north of the Orange County line and about six miles west of Corona, will be the first item of major importance in the plan to be undertaken. The dam is to be an earth-fill structure, 2,400 feet long and 100 feet in height above the valley floor. The outlet works will consist of a control tower with conduits, supplemented with an emergency open-concrete spillway. Detailed plans are now in preparation. The basin will have a capacity of about 325,000 acre feet at maximum water-surface elevation. It will have the effect of reducing the peak flow by 115,000 c.f.s. Stored water will be utilized as much as practicable, particularly to recharge underground supplies.

Los Angeles County Drainage Area, California. The general plan of control development by the Los Angeles County Flood Control District embraces the construction of dams in the mountains, of basins to retain the debris from tributary streams at the canyon mouths, of concrete lined channels to carry storm run-off from these basins down the steep slopes to the main channels, and the

requirements for reclamation of arid lands are predominant. Idaho created a State Water Conservation Board.[11] Oregon[12] authorized its state engineer to cooperate with state and federal agencies in an investigation of the Grand Ronde project. Texas[13] declared that the use of lands, dams, and other works constructed on streams by conservation and reclamation districts for the purpose of conserving and developing the natural resources of the state is superior to all other uses. Wyoming provided for the creation of public irrigation and public power districts and for cooperation with other states and the federal government.

Almost from the outset of this work, the Bureau of Reclamation has concurrently constructed projects of two types; one to improve areas previously irrigated but inadequately supplied with water, and the other to water new lands.

At present, the program of the Bureau is about equally divided between the two types. An important example of the first of these types, now under construction, is the Central Valley project in California, designed to provide supplemental water for 1,000,000 acres in the highly developed San Joaquin Valley where available underground water supplies have been overtaxed and are being exhausted. A comparable example of the second type is the Grand Coulee Dam-Columbia Basin project, designed to provide water for 1,200,000 acres of rich but dry land now largely untilled.

From time to time, emphasis has shifted from one type of project to the other. During the World War, when quantities of new lands were needed to provide food for the armies, new projects were emphasized; and during the extended drought which began in 1930, emphasis shifted to supplementing existing irrigation systems. Present conditions call for the construction of both types of projects, as reflected in the accompanying project list.

Construction now in progress includes both large and comparatively small projects. Outstanding among the new proposals is the Colorado-Big Thompson Transmountain Diversion project, for which Congress made an initial appropriation, but which has not been started. This project will divert, from the headwaters of the Colorado River through a tunnel 13.1 miles long under the Continental Divide, about 300,000 acre feet of water annually to supple-

[11] Idaho Laws of 1937, Chapter 95.
[12] Oregon Laws of 1937, Chapter 289, approved March 8, 1937.
[13] Texas Laws, Title 52, Chapter 2, approved June 9, 1937.

ment the supply in the South Platte Valley of eastern Colorado. Notable projects, for the completion of which additional funds are needed, include the Provo River project in Utah and Bartlett Dam in Arizona which will make available supplemental water for the Salt River project. The Central Valley project, although it will serve multiple purposes, is included here because the need of a supplemental water supply for lands now irrigated primarily motivated its construction at this time. During the next six years this project will need $99,000,000, after which $47,300,000 will be required for its completion. Its total cost is $170,000,000.

Projects now under construction to provide water for new lands fall into two groups. The more numerous group is made up of extensions from existing systems to irrigate new lands; the requisite storage facilities were provided when the projects were begun and the first units completed. Projects of this type include the Roza Division of the Yakima project in Washington, the Payette Division of the Boise Project in Idaho, and the Heart Mountain Division of the Shoshone project in Wyoming.

The second group is made up of new projects designed to provide water for lands now unirrigated. There are two notable projects in this group, namely the Grand Coulee Dam-Columbia Basin project and the Gila project. The latter will irrigate about 150,000 acres of desert, mostly public lands, near Yuma, Arizona.

Drainage

No new developments in national drainage policy or Congressional enactments in the field of drainage marked the year 1936-37. However, several states passed laws to provide for organized regional, district, or state-wide reclamation of wet land, swamp land, or overflowed land for agricultural purposes or for elimination or abatement of the mosquito nuisance.

Alabama[14] made each county of the state a drainage district for the purpose of establishing and developing drainage sub-districts and provided for the creation of County Boards of Commissioners which should have authority to enter into contracts with any agency of the federal government.

The State Drainage Engineer of Maryland[15] was instructed to promote and encourage the drainage of agricultural lands in the

[14] State of Alabama, Act No. 127, Extra Session of 1936, approved April 15, 1936.
[15] State of Maryland, Laws of 1937, Chapter 465, approved May 18, 1937.

state, to correlate the activities of local drainage organizations, and to cooperate with state and federal agencies in the interest of a program of improved drainage.

Land drainage has had a material effect upon the development of the United States. Promotion of agriculture, reduction of health hazards, and elimination of pest mosquitoes have been major objectives. Large areas of highly developed land, as in northwestern Ohio, northern Indiana, central Illinois, and north-central Iowa were once swamps or marshes. The present high state of land development and the satisfactory conditions of health in these areas were made possible by drainage. If the drainage works are not maintained, the areas will revert in a comparatively short time to their previous swampy or marshy condition.

Since drainage is primarily of local importance, federal participation in it has been limited and has taken the form of technical advice and of emergency aid in construction and financial organization during the past forty years. State policies with respect to drainage vary greatly. Federal drainage policies are not thoroughly integrated. The essentials of a suitable national drainage policy seem clear, however, and state and federal action necessary to effectuate such a policy is recommended.

Virtually all land drainage in the United States has been accomplished by farmers acting individually or as groups without legal organization, or through the medium of local public districts organized under state drainage laws. By 1930, approximately $680,000,000 had been expended by organized enterprises in furnishing outlet drainage for some 84,000,000 acres of land. This expenditure does not include millions of dollars spent by individual farmers on field ditches and tile drains. Of the 84,000,000 acres of land in organized enterprises, 7,400,000 have not been drained sufficiently to permit the growth of crops, and an additional 10,700,000 have been drained sufficiently to permit cultivation only in dry years. No estimates are available of the acreage drained wholly or chiefly for malaria abatement or control of pest mosquitoes.

The expenditures indicated were made entirely from state, county, municipal, or private funds. Much of the land had been donated to the states by the federal government under the Swamp Land Acts of 1849, 1850, and 1860. The operation of old districts and the formation of new districts are within the exclusive jurisdiction of local and state governments.

The federal government now participates in drainage through (1) loans by the Reconstruction Finance Corporation for the rehabilitation of existing districts, (2) Civilian Conservation Corps labor contributed to the maintenance of ditches in organized districts, and (3) grants of emergency relief funds. During the past four years the Reconstruction Finance Corporation has made loans exceeding $40,000,000 to drainage enterprises embracing more than 12,600,000 acres. The Civilian Conservation Corps has had 46 camps engaged primarily in drainage work. The Works Progress Administration has authorized drainage undertakings to cost more than $145,000,000, of which approximately a quarter have been undertaken.

For the most part, the undertakings to date have been successful. Nevertheless, there have been some instances of unsound and ill-advised development which have resulted from hasty action and from failure to recognize all the effects of lowering the water table. The complexity of the subject of land drainage is illustrated by the problems relating to the abandonment of drainage districts, the financial rehabilitation of districts, the maintenance of drainage works, the development of new crop lands, the effects of drainage upon stream-flow and ground water, and the effect of drainage upon wild life habitat.[16]

Approximately one-twelfth of the land in organized drainage enterprises has been abandoned. Most of this land is in the Florida Everglades and in northern Minnesota, in both of which attempts have been made to drain land largely unsuited for agriculture. Outside of those areas less than 2 per cent of the land in organized drainage enterprises has been abandoned. The engineering designs of some of these enterprises were inadequate, some were unduly costly, and some resulted in permanent damage to land which was not suited for agricultural use. For example, drainage districts in the Illinois Valley have encroached upon the flood plain and in some instances the cost has been excessive. The flood hazard has thus been increased, and wild life habitat has been destroyed. Nevertheless, Congressional authorization has been given for additional flood protection in the localities involved. In this and other

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[16] For a detailed discussion of the agricultural problems associated with land drainage see "Land Available for Agriculture Through Reclamation," Part IV, *Supplementary Report,* Land Planning Committee, National Resources Board, 1936, pp. 35-41.

areas, government agencies have a choice between encouraging the revival of ill-advised or over-extended districts and facilitating their abandonment.

Many drainage enterprises have had financial trouble since the World War, due to over-expansion of agriculture at that time, to land speculation and later collapse of land values, to reduced income resulting from low prices for agricultural commodities, or to special local conditions. Landowners and tenants still are occupying most of the land involved and are trying to save the investment in it. Because of lack of funds, the maintenance of essential drainage works has been neglected in many areas and in some areas malarial conditions have returned. The efforts of the Reconstruction Finance Corporation in this field have been directed primarily to refinancing work in organized districts. Obviously, however, little or nothing is gained by promoting the rehabilitation or construction of enterprises which subsequently fall into disrepair.

The value of drainage already accomplished in the rich agricultural areas of northwestern Ohio, northern Indiana, central Illinois, and northern Iowa is undoubted. In view of present land requirements for agriculture there is some doubt, however, as to the desirability of bringing more land under cultivation by drainage without careful consideration of the value of the undrained land for wild life refuges and forest reserves. Thus, new projects which might appear feasible from a local standpoint may be unjustified when viewed from the standpoint of regional or national economy.

The effect of land drainage upon streamflow is not known quantitatively. It probably has an insignificant effect in most sections, though in some, such as the Yazoo Basin in Mississippi, the regimen of streams has been changed greatly by headwater drainage. Similarly, the burning of peat lands in Northern Minnesota, after their partial drainage and subsequent abandonment has created serious water problems.

Drainage is an important phase of malaria control in the southeastern states. Independently or in association with house-screening, treating ponds with suitable oils, and other measures, it helps to control malaria. Many malaria hazards have been created by logging operations, by poorly designed and operated storage reservoirs, and by road, levee, and other earth construction activities. The laws of some states restrict such operations adequately. In most states the provisions are inadequate or uninforced. From time to time, some

work with federal aid has failed to conform to public-health standards. In some instances, drainage for purposes of agricultural production or pest-mosquito control has been undertaken in the name of malaria control. In other instances, there is doubt as to the desirability of malaria-control drainage when it is compared with other methods of malaria control and with damages to wild life habitat. Malaria control or pest-mosquito eradication is the object of most of the land drainage now being undertaken or planned. The resulting destruction of wild life habitat is sometimes needless, particularly in coastal marshes, and has aroused vigorous opposition. Much of the work is opposed by wild life conservationists on the ground that although malaria control and pest-mosquito control are necessary, drainage is not always essential to such control. No general statement concerning the necessity of drainage work can be made in answer to these contentions, but it can be asserted that the complications which may arise from malaria-control drainage make it important that each new project be evaluated carefully in advance of construction.

After consideration of the diverse aspects of drainage work as illustrated by the foregoing problems it is the opinion of the Subcommittee [17] on Drainage Policy and Projects that a national drainage policy involves the following objectives:

1. Land drainage should be evaluated as one of many devices for increasing agricultural productivity or for controlling insects and diseases. New enterprises or the rehabilitation of old enterprises should be undertaken only after careful examination of possible benefits to agriculture and health, and of the effects on wild life and wild life habitat, on municipal water supply, and on other uses of the wet land, and of the alternative beneficial uses of the land. The most beneficial use or combination of uses of the land should be determined. All possible benefits and damages resulting from the proposed drainage work should be analyzed. The cost of alternative methods of improving productivity or controlling insects should be considered.

2. Where water is to be impounded for power, recreation, wild life conservation, or other purpose, the malaria hazard that may be created should be appraised. Where the hazard is found to be greater than the probable benefits, the water should not be impounded, unless provision for prevention of malaria is made.

[17] Of the Water Resources Committee.

3. In view of the apparent surplus of land already in cultivation, public funds should not be expended to bring new land into cultivation by drainage, unless investigation has disclosed that the drainage would be economically feasible and that the area would be self-supporting.

4. Drainage of farm lands now in cultivation for the purpose of increasing production should be undertaken only if the probable increase in farm income would exceed the cost of the drainage.

5. Drainage of wet lands which constitute a real malaria hazard to permanent settlements within a distance of not more than one mile of the wet area (except in the west) is warranted in the interest of public health.

6. Drainage of wet lands to eliminate pest mosquitoes (exclusive of malaria-carrying mosquitoes) should be undertaken only if the public benefits from such elimination would exceed the damages to existing or potential values.

7. Under no circumstances should federal financial assistance be given to drainage projects unless responsible local interests guarantee that the projects will be operated and maintained in good order.

8. In the construction of roads, levees, and other earthworks, appropriate precautions should be taken, if practicable, to prevent the formation of new breeding places for mosquitoes.

9. Drainage enterprises which are economically unsound should be converted to other uses. Federal assistance should be given, where justified, to transformation into wild life refuges.

10. Wherever drainage is feasible and necessary, but would injure wild life habitat, the work should be designed so as to cause the minimum practicable amount of damage.

Highway Planning Surveys

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State-wide highway planning surveys are now being carried on in cooperation with the Bureau of Public Roads by forty-four states, and are planned in two of the remaining states. They comprise an inventory of all rural roads, traffic surveys, a financial and road-use survey, and certain safety studies.

The purpose of the surveys is to ascertain the present extent and condition of rural highways in all the states, to measure their usefulness and the value of the service obtained by their users, to select that part of all these roads which ought to be included in an improvement program leading to the development of a complete national system of primary and secondary or feeder roads, and to provide facts to be used in estimating the cost of owning and maintaining such a system. One of the immediate objectives is the selection of secondary roads to be added to the state highway systems under the provisions of the Hayden-Cartwright Act of 1934, which provided for the first time that federal-aid funds could be used on "secondary or feeder roads, including farm-to-market roads, rural free delivery mail roads, and public school bus routes."

Each state highway planning survey is a separate cooperative project, in which the state is responsible for the administration and execution of the program and for part of the cost. The Bureau of Public Roads cooperates by contributing federal funds, by recommending a uniform procedure so that all the data obtained will be comparable, and by contributing technical advice.

The survey organization is under the jurisdiction of the state highway department, but is distinct from other branches of the department. The organization is headed by a State Manager, who has ordinarily three assistants in charge respectively of the road inventory, the traffic survey, and the financial studies. The State Manager works in close cooperation with a representative of the Bureau of Public Roads, generally referred to as the Bureau Manager, whose duty it is to advise the State Manager in administering the project in such a way that both state and federal funds will be well spent in accordance with the agreement between the state and the Bureau. The Bureau Manager is the liaison officer between the state and the Bureau.

Road Inventory the First Step

The road inventory is a prime necessity in the planning surveys. Of the estimated 3,000,000 miles of rural road in the United States, only the state-controlled mileage of 537,000 miles (including the federal-aid system of 220,000 miles) is recorded or mapped with any degree of accuracy. The estimated 2,463,000 miles under the jurisdiction of local authorities includes roads of all types and usefulness, but there are no adequate records of their extent, their condition, or

their use. The first step in planning, therefore, is to get those facts.

The road inventory is carried on by field parties. The party chiefs report directly to supervisors, each of whom is responsible for several parties, and who report to the road inventory manager.

Each party, consisting of a party chief, a recorder, and a chainman, is assigned a car with an odometer, a compass with compensator, a clinometer, and other necessary instruments. Odometer readings, compass bearings, etc., are carefully recorded in field notes in such form that they can be readily transferred to maps and tabulated at headquarters. In the general phase of the road inventory the party obtains the following data: The location, administrative classification, classification by type of surface (under one of nine classifications), length, width, riding qualities of and defects in the pavement of all public roads outside, and principal connections through cities, incorporated towns, and villages; the location and length of excessive grades; location and description of bridges, culverts, drainage structures with a clear span of twenty feet or more, and grade separation structures; location and description of railroad grade crossings; location and description of important structures off and alongside the highway, such as farm units, mills, factories, dwellings, schools, churches, and other places of public assembly whose location may have an effect on traffic using the road.

Special parties record significant data as to locations where sight distance is inadequate, grades and curves are excessive, and the degree of superelevation insufficient.

Special studies are made at railroad grade crossings both on rural roads and within cities in cooperation with the railroads. The purpose of these studies is to obtain facts on traffic volume both on the highway and on the railroad, data on accidents, and other information which will be used as a guide in establishing a priority list of grade crossings to be eliminated.

The statistical tabulations made as a result of the road inventory will be very valuable, but the maps are its most important contribution. All the data recorded in the field notes will be placed on county base maps. In addition, railroad lines, navigable waterways, the location of railroad stations, ferries, and airports will be shown.

The usefulness of these maps in highway planning is obvious, but it cannot be fully measured in terms of highway planning alone. They are already in demand for a variety of uses, by county, state and federal offices and bureaus, by manufacturers, advertising

gencies, transportation companies, public utilities, and many other iterested groups.

The statistical tables present the same data in another form which hould be equally useful.

Traffic Counts

The traffic surveys include traffic counts on main roads and on ocal roads, continuous hourly counts by automatic traffic recorders, he weighing of commercial vehicles on loadometers and pit scales, udies of the origin and destination of commodities and passengers, nd a study of loading practices. They are all carried on under the eneral supervision of the traffic survey manager with a staff of ipervisors who are each responsible for the work of several parties. The two types of traffic counts, key station and blanket counts, are nade by one man, and the loadometer and pit-scale operations by our- or five-man parties.

The key station counts are made only on main highways and eavily traveled secondary roads, generally at intersections. The staons are at the most important points on the system. Seven times, ach on a different day of the week throughout the year, traffic is ounted at each station from 6 A.M. to 2 P.M.; seven times from P.M. to 10 P.M.; and three or four times from 10 P.M. to 6 A.M. The ay counts (6-2 and 2-10) are alternated on a schedule which proides that a one-day count will be made at each station every twentyx days, each party being assigned a circuit of eighteen stations. Thus these sample counts are made under all conditions, so that ariations by hours, days, weeks, and seasons can be properly noted. rom the samples the total traffic for the year with all its variations an be accurately estimated in miles and vehicle miles. In recording he traffic the recorder classifies it as foreign (out-of-state) and local, nd by type and size of vehicle, as passenger car; light, medium, r heavy truck; school bus, or commercial bus.

The blanket counts are made on local roads at a greater number f stations, but less frequently at each station. At most stations only ne count is made, from 8 A.M. to 4 P.M., but at certain "control" tations counts are made at other periods of the day as at key staions, and at some stations the counts are made four times, during he period from early spring to late fall, in order to ascertain seaonal variations. The blanket count operations include a limited rigin-and-destination study, in that the recorders ask drivers of

trucks whether they are going to or coming from a railroad station or a wharf.

Automatic traffic recorders are an innovation in traffic survey work. They make use of the photoelectric cell to record passing traffic. Each vehicle passing these machines intercepts two parallel beams of light projected horizontally across the road to focus on photoelectric cells. When both beams of light are simultaneously intercepted, the reading on a cumulative counting device is advanced by one unit. Once each hour, on the hour, the day of the week, the hour of the day, and the cumulative counter reading are automatically printed on a paper recording tape.

Records of this type obtained continuously for a period of years will provide basis for studying fluctuations in traffic at numerous points located on roads of all types. Variations during the twenty-four hours of the day, the seven days of the week, the weeks of the year, and even during the years can be scientifically studied. Statistical analyses of the information will include the isolation of individual factors influencing the movement of traffic, as, for example, the long-time trend over many years, the effect of business cycles, the effect of local economic conditions, the effect of seasonal variations, etc. A study of similar tendencies of isolated influencing factors will make it possible to identify many variations which have heretofore been puzzling. Later these variations can even be predicted. Other analyses of the continuous records will be directed toward the development of the most economical method of sampling traffic in future years. The use of the records for reference purposes during the expansion of any short sample count is evident.

Load Data

The loadometer operations are combinations of two studies. They are made by parties of four or five men, including a chief, a recorder, two weighers, and if possible a traffic officer. The operation consists of weighing the trucks and busses, and recording the wheel loads thus determined; and in recording the nature of the commodity hauled, the length of the trip, the place of ownership of the vehicle, the origin and destination, the type of origin and destination (farm, factory, warehouse, retail store, railroad station, etc.). The party also notes the type and size of the vehicles, the place of ownership, the class of service performed (whether common carrier, contract hauler, etc.), state of registration, and other data.

In addition to the origin-and-destination study of commercial vehicles mentioned above, another covers all vehicles, including privately-owned cars. The purpose of these studies is to solve problems of rerouting traffic through congested areas by means of bypass roads; to determine the value of proposed new roads; and to learn, by carrying on such studies near toll bridges and ferries, the value the average motorist places on savings of time and distance.

The value to highway engineers of the data obtained by weighing trucks is obvious. The origin-and-destination studies are also useful to the engineer because they show the extent to which these vehicles use the different roads in the state. A wider use is found for commodity and origin-and-destination studies by those concerned with transportation in general or specifically, such as shippers, manufacturers, railroads, truck companies, and others. The data obtained in these studies will help to develop the true picture of commodity movement over the highways.

Pit scales, generally three to five in number, are located for purposes of the highway planning surveys at points where truck traffic is typical and its volume is large. Each pit-scale party consists of a chief, who also acts as recorder, a weigher, and two "measurement men." Unlike the loadometer parties, whose working schedules are similar to those of the key station parties, the pit-scale party spends six weeks at a time at each scale. The data obtained includes axle weights, the maximum length, height, and width of the vehicle or combination of vehicles (as a tractor-truck semitrailer) and its load, the tire sizes, wheel base, commodity carried, etc.

The pit-scale data will be useful to highway engineers, shippers, producers, etc., and valuable in any study of marketing or transportation. One of its particular purposes is to ascertain just what loading practices are found most efficient and economical by truck operators, as a guide in drawing up regulations restricting the dimensions of and loads carried by trucks. The data should also be useful in determining a fairer and more adequate basis for taxation of vehicles, and in helping to bring about more nearly uniform legislation in the different states.

Safety Studies

The planning of highways must necessarily include a consideration of highway safety. It is true that the factors causing accidents are many and various, and that most of them are beyond the con-

trol of the highway engineer, but it is his responsibility to do all he can to prevent accidents from occurring as the result of faulty design or construction of the highway, and to discover and correct such hazards where they now exist. To determine the extent to which the highway contributes to accidents, certain studies are planned, the objectives of which will be the determination of rates of accident occurrence at intersections; railroad grade crossings, curves, tangents, etc., taking into consideration such elements as shoulder design, surface types and widths, and sight distance. These rates in terms of vehicle miles will be based on the actual use of the highways.

The five general phases of these studies are:

1. Highway Capacity Studies
2. Grade Ability Studies
3. Passing Distance Studies
4. Vehicle Behavior Studies
5. Driver Studies

They are arranged in the order in which field work is expected to develop.

The Highway Capacity Studies will develop the actual facility of movement, both of the average and of the individual vehicle, under a variety of conditions of alignment, width and traffic volume. These studies will produce such fundamental data regarding speeds and spacings of vehicles as may be necessary for use in theoretical consideration of highway design.

The Grade Ability Studies will be a continuation of the field work carried on during the summer of 1937 in Maryland. It is anticipated that from detailed studies of a number of trucks of which the specifications are definitely known, the maximum performance under various loadings and on various grades can be determined. Studies will be made on both new trucks and random trucks encountered in regular use on the highway, to determine how the performance of the average truck as it actually is driven compares with the maximum performance determined from the test trucks. Both laboratory and field tests will be made on the test trucks.

The Passing Distance Studies will entail a detailed study of the individual vehicles involved in passing maneuvers on roads of various grades and alignments. The samples taken will include the full range of speeds available to present-day cars and since passing is a

function of sight distance, the studies will be made on tangents, both level and ascending and descending grades of various percentages, and on curves.

Vehicle Behavior Studies are designed to show how the highway itself affects the movement of vehicles. There will be included studies to show how details of construction affect vehicular movement, and studies to determine how the general alignment of a road affects driving.

Driver Studies will include determination of the period termed "perception or judgment time" and such other data as may be required to demonstrate the minimum distance which may be called a safe sight distance.

Other phases of the planning surveys also provide data which will be useful in establishing the responsibility of the highway for accidents. The studies of critical sight distance, curvature, grades and superelevation in the road inventory are for the purpose of locating such danger spots and potential hazards so they may be eliminated. The railroad grade crossing studies are intended to facilitate the continuation of the work of abating one of the most menacing of all sources of fatal highway accidents.

Financial Surveys

The road inventory, the traffic surveys, and the safety studies provide much of the information needed for the planning of the future highway system, but they are not sufficient. We must know how much additional mileage of highways we can plan, or more pertinently, how much the people of the country are able and willing to pay for constructing, improving, and maintaining perpetually a highway system; and how much additional mileage will repay in service the continuing costs of improving it. The financial surveys are producing the facts needed to complete the answers to those questions.

Specifically, the objectives of the financial surveys are to determine the present and probable future sources of revenue for the operation of adequate highway systems within the states, and the determination of equitable bases for the levying of specific highway-use taxes based on present use and benefits derived from the highways.

The financial survey's four phases cover a study of income, expenditures, and debts of the state and of all the subdivisions within

the state, including counties, townships, and municipalities, and overlapping jurisdictions such as water and sanitary districts, school districts, etc.; a study of the location or place of ownership of taxable motor vehicles; a road-use study; and a road-life study.

The fiscal study is carried on under the supervision of an assistant to the State Manager. The number of employes engaged in this work varies according to conditions in the particular state, such as the manner in which financial records are kept, the number of local offices where accounts and records must be inspected, etc. All the items of income and expenditure of all the units of government within the state are studied, and the figures are broken down so that the receipts and expenditures for all purposes can be compared in order to show the extent to which highway users provide funds for highway activities as compared to receipts from other sources and expenditures for other purposes.

The motor vehicle allocation study is intended primarily to produce facts showing the proportion of motor vehicle taxpayers located in rural as compared with urban communities. The information is obtained by means of questionnaires which are mailed to the owners of about one-third of the private passenger cars and to all the persons in whose names trucks and busses are registered. In most states the questionnaires are sent out with the application blanks for registration. A certain number of extra clerks are assigned for this purpose to the office in which registrations are handled. The questionnaires sent to passenger car owners include the following items: Residence of owner, make and year of car, registration fee, months in operation during the last year, miles traveled during the last year, and average miles per gallon. The truck and bus questionnaires include also the rated capacity in tons or passengers.

The purpose of the road-use study is to determine to what extent the different types of rural roads are used by different types of users. The field work is carried on by personnel who obtain the data by means of personal interviews with representative motor vehicle owners. The information obtained includes the occupation of the driver, his residence, the mileage he drove during the past year, estimates of the proportion driven on primary, secondary, and local roads and streets, the distance he lives from a primary, secondary, or township road, the purpose of travel (as business or pleasure), and other data including make and model of car or truck, license fee paid, gasoline consumed, etc.

The data obtained in the road-use and motor vehicle allocation studies will serve to show whether the average driver pays for the roads in proportion to his use of them, or vice versa, and, for example, will be very useful in answering such controversial questions as whether the city driver pays more than his share of the cost of the rural roads.

The road-life study is made from records in the state highway department, and is usually confined to roads in the main highway system. Its two main objectives are the determination of the probable average service life and rates of retirement for each type of surfacing in order that the future necessary reconstruction can be forecast, and the determination of the annual roadway cost for the several types of surfaces. Summaries of the construction and retirement year by year are made in order that "life tables" and curves can be computed and the probable average life determined. In this respect the work done is very similar to that of the life insurance actuary, who calculates the probable life of human beings. To determine the annual cost, the investigators ascertain the probable average life, the maintenance cost, the probable salvage value, and the construction cost, as these factors all bear on the annual roadway costs.

Progress to Date

Most of the states have completed the field work of the planning surveys, and are now engaged in tabulating and analyzing the data. The great mass of data accumulated requires the use of punch cards and modern sorting, tabulating, and other machines rented for the time necessary.

A considerable amount of information obtained in the studies has been used by the state highway departments for their immediate programs, and by other state and federal bureaus, but much work remains to be done before any reports are ready for general circulation.

The work described above is not to be considered as complete when the present program has been carried out. While it does represent a long step and a very important forward one in the administration and planning of our highways, it is only a first step. To gain the full value of these studies, the states must continue the work from year to year, keeping current and up to date the maps and all the other basic information now being compiled. Several of the states have already established highway planning divisions as per-

manent units in their highway departments, and it is expected that eventually they will all do so. When that has been accomplished, we shall have reached our first objective. We shall know the actual extent and condition of our highways, how adequately they are serving their purpose, how we shall be able to correct their inadequacies, and we shall be able to estimate the cost of an adequate highway system.

Field Engineering

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THERE appear to be three discernible trends in field engineering at present: toward the adoption of state plane coordinates; precise control for city surveys; and widespread aerial mapping.

STATE PLANE COORDINATES

Engineers are gradually beginning to appreciate that the U. S. Coast and Geodetic Survey has done something unusually valuable and practical for the whole country by planning state coordinate systems and calculating the plane coordinates of their existing control points for local use. Computations were completed for the forty-eight state systems early in 1934, and state publications have been issued for Tennessee, California, and Minnesota which contain both the geographic positions and the plane coordinates of existing stations. Extensive use is being made of these coordinates and the following states are conducting state-wide local geodetic control surveys: Alabama, Arkansas, Connecticut, Florida, Georgia, Iowa, Louisiana, Massachusetts, New Jersey, North Carolina, Okla-

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homa, South Carolina, Tennessee, and Virginia. Florida has published a geodetic control report and the results of mapping to date. Georgia has this work nearly completed and ready for publication and the State Highway Department has adopted the system. Engineers of North Carolina were the first to ask for this service for a state, and Pennsylvania and New Jersey have adopted their coordinate systems by law. Denver is one of the first cities which decided to use the state coordinates, after thoroughly considering four different systems.

Three bills providing for Pennsylvania the use in all future surveying of the standard, state-wide system of plane coordinates based on the National Triangulation System were enacted into law at the recent session of the state legislature. These bills were sponsored by the State Planning Board, having been drafted by the Board with the assistance of the United States Coast and Geodetic Survey.

The most important of these Acts (No. 310) establishes the "Pennsylvania Coordinate System" for describing the location of survey monuments and land boundary corners. By means of this system the positions of survey stations can be described in terms of their distance in feet east and north of an assumed "origin," or zero point for calculation. A second Act (No. 123) gives the State Department of Internal Affairs power to establish and regulate the "Pennsylvania Coordinate System," while the third Act (No. 302) permits the entry of surveyors and engineers upon private property when necessary for the purpose of using the survey stations. It also provides for the assessment and collection of damages done in the course of such entry, and provides for the protection of the markers themselves.

A controlled survey, being absolutely permanent, may be used at any time in the future for any number of purposes aside from that for which it was originally made. In fact, the value of a large system of controlled surveys properly designed and monumented is so great and covers so many fields of utility that it defies estimation. Such surveys may be used for general mapping, highway and railway location for controlling topographic and hydrographic surveys, for military purposes, for flood control, for irrigation and reclamation, for geological and geographical studies, for controlling aerial photography, for cadastral or tax base surveys and, in general, for all surveying purposes.

No portion of a spherical surface can be spread out onto a plane without some distortion. In order, therefore, to portray a portion of the surface of the earth as a plane, some sort of projection having a definite mathematical relationship to the spheroid is necessary. The newly enacted system utilizes the Lambert Conformal Projection for this purpose.

This projection has an inherent scale error varying along the north and south axis, from zero at the standard parallels to a maximum at the greatest distance from the standard parallels. By utilizing two zones or grids, the maximum scale error will be 1 part in 23,000 or less than 3 inches in a mile. This scale error is such that it may be disregarded entirely for most surveys. However, for surveys covering a large area, or where a high degree of precision is required, corrections for this scale error can easily be made.

The Lambert Secant Cone used for Pennsylvania North Grid enters the earth's surface on the standard parallel at North Latitude 41 degrees 57 minutes. It emerges on a standard parallel at North Latitude 40 degrees 53 minutes. Likewise the cone used for the South Grid enters the earth at North Latitude 40 degrees 58 minutes and leaves it at North Latitude 39 degrees 56 minutes. The Central Meridian used for both North and South Grids is at Longitude 77 degrees 45 minutes West of Greenwich and serves as the Y axis. A line tangent to the parallel 40 degrees 10 minutes where it intersects this Meridian, serves as the X axis for the North Grid; the point of intersection being the working origin. Similarly the intersection of this Central Meridian with a line tangent to parallel 39 degrees 20 minutes constitutes the working origin for the South Grid.

The Coast and Geodetic Survey has prepared a set of tables for Pennsylvania known as the "Plane Coordinate Projection Tables" which give for every minute of latitude and longitude on the ellipsoid the corresponding polar coordinates, on the developed conical surface. These tables give the logarithm of the scale error and the scale correction ratio for each minute of latitude. Straight line interpolation is used to correct for seconds of latitude or longitude and corrections per second for this purpose are given in the tables.

The "first order" triangulation system, upon which the Pennsylvania Plane Coordinate System is based, will give 25 mile spac-

ing of arcs in Pennsylvania and is well on its way toward completion. This spacing, however, is so broad that the distances from the triangulation stations to the points of beginning of many future surveys will often be so great as to make their use prohibitive. If a practical system is to be developed, the area between arcs must be split by supplementary triangulation and traverse. Stations will eventually be placed at such intervals that no point in the state will be more than one or two miles from a permanent monument.

City Precise Control

The U. S. Geological Survey is engaged in making a complete topographic map of Denver, with precise control based on the state coordinates of four triangulation stations of the national network. This topographic survey is unique in many respects and is described by H. S. Senseney in the *Geodetic Letter* for January 1937, published by the U. S. Coast and Geodetic Survey. The maps are to be 20 x 25 inches to the scale of 200 feet to the inch, with two-foot contour intervals. An increasing number of applications for projects on geodetic control surveys are being submitted to the Works Progress Administration; and several large cities, including Minneapolis, Cleveland, and Boston, are already engaged in such enterprises, as well as states. Chicago has proposed starting this work as a W.P.A. project.

There are also county-wide geodetic control survey projects now in operation and there is a trend toward more of this work to supplement city and borough planning and the describing of property by the use of precise plane coordinates.

Aerial Surveying

The Agricultural Adjustment Administration and the U. S. Soil Conservation Service are making use of aerial photographs for mapping enormous areas. For instance, in Wisconsin over 10,000 square miles in eighteen counties are being photographed, and even larger areas in several other states are being mapped from the air this year. Ground control is necessary in this work to determine the enlargement factor, as the original photographs are increased in size until the scale is exactly ⅛ inch to the mile. This is done so that areas of ground can be accurately measured with a planimeter.

Index of Articles and Books

Recent articles and books considered of interest in field engineering and not listed in previous reports are indexed below:

Boundaries: Geodetic Control for a County Line; Plane-Coordinate System. P. Kissam. With illus. and map. Civil Engineering, 7:399, June, 1937.

Stabilizing the Rio Grande; International Border is Being Straightened. L. M. Lawson. With illus. Scientific American, 155:66, Aug., 1936.

Geodesy: Practical Use of Horizontal Geodetic Control. R. C. Sheldon. Am. Soc. C. E. Proceedings, 63:657, April, 1937. Discussion 63:1425, 1815, Nov., 1937.

Report of the Association of Geodesy. W. D. Lambert. Science, 85:122, Jan. 29, 1937.

Simplified Method of Determining True Bearing of a Line. P. L. Inch. With diagrams. Am. Soc. C. E. Proceedings, 62:991, Sept., 1936. Discussion 62:1464, 1661; 63:166, 343, 571, 1081, Nov. and Dec., 1936, March and June, 1937.

Geological Maps: Mapping of Areas in Northwestern Quebec. Science, 84:412, Nov. 6, 1936.

Mapping Underground Geology. H. Schmitt. With diagrams. Engineering and Mining Journal, 137:557, Nov., 1936.

Geological Surveys: Geological Survey of Newfoundland Revived. A. K. Snellgrove. With map. Science, 85:220, Feb. 26, 1937.

Leveling: Spirit Leveling in Connecticut, 1922-35. J. G. Staack. With map. U. S. Geological Survey Bull. 881, 65pp., 1 plate. 1937.

Spirit Leveling in Massachusetts, 1922-35. J. G. Staack. With map. U. S. Geological Survey Bull. 882, 156pp. 1937.

Spirit Leveling in Texas, Part I, Western Texas, 1896-1935. J. G. Staack. With maps. U. S. Geological Survey Bull. 883-A, 50pp. 1937.

Maps: Application of Maps to Engineering Practice. J. C. Carpenter. With illus. and maps. Civil Engineering, 7:504, July, 1937.

Better Maps for More People. With illus. Nation's Business, 25:26, Aug., 1937.

Mapping: Air-Mapping the Brazos River Area. E. Haquinius. With illus. and maps. Civil Engineering, 7:509, July, 1937.

Method for Geographic Surveying. J. M. Trefethen. With diagrams and map. American Journal of Science, 5th Ser., 32:454, Dec., 1936.

Mapping—Aerial: Aerial Maps, Greatly Improved, Simplify Work of Geologist and Engineer. G. S. Rice, Jr. and J. C. Atkinson. With illus. Mining and Metallurgy, 17:569, Dec., 1936.

Correlating Ground and Air Surveys; How Maps Are Made From Aerial Photographs. A. W. Lambert, Jr. With illus. and diagrams. Civil Engineering, 6:732, Nov., 1936.

Multi-lens Camera for Aerial Mapping. With illus. Engineering News-Record, 117:617, Oct., 1936.

Multiplex Projector Makes Stereoscopic Maps. Steel, 101:58, Nov. 29, 1937.

River Valley Aerial Maps Aid in Placing Crossing. L. G. E. Bignell. With map. Oil and Gas Journal, 35:150, Sept. 24, 1936.

Photographic Surveying: Photogrammetric Surveys Give Dam and Quarry Yardage in San Gabriel Canyon. P. Baumann. With illus. and map. Engineering News-Record, 117:915, Dec. 31, 1936.

Reconnaissance for the Chisos Highway. D. C. Wells. With illus. and map. Civil Engineering, 7:479, July, 1937.

SOUNDINGS: L'appareil Husun B.B.T., pour le Sondage en Mer ou en Rivière. With illus. and diagrams. Génie Civil, 110:294, Mar. 27, 1937.

SURVEYING: Adjusting Rough Transverse. L. Pratt. Engineering News-Record, 117:616, Oct. 29, 1936.

Coordinates Aid Survey of Fairmont Region. L. E. Yoder. With diagrams and maps. Civil Engineering, 7:37, Jan., 1937.

County Topographic Survey and Its Benefits; with Cost Data. J. A. Long. With illus. Roads and Streets, 79:47, Dec., 1936.

Development of State Grid Systems. O. S. Adams. With illus., diagrams and maps. Civil Engineering, 7:33, Jan., 1937.

Digest of Surveying Teachers' Conference. With illus. Civil Engineering, 7:884, Dec., 1937.

Elementary Surveying. W. H. Raynor, 380pp. $3. Van Nostrand, 1937.

Essentials of Engineering Astronomy. J. H. Service. 167pp. $2.50. Prentice-Hall, 1937.

Establishing Massachusetts Plane Coordinates. With illus. Civil Engineering, 7:825, Dec., 1937.

First Surveying Teachers' Conference. Journal of Engineering Education, 28:211, Nov., 1937.

Hartford Conducts a Regional Geodetic Survey. C. W. Cooke. With illus. and maps. Engineering News-Record, 117:431, Sept. 24, 1936.

Land-Title Discrepancies Present Surveying Difficulties. H. P. Coloney. With plans. Engineering News-Record, 117:307, Aug. 27, 1936. Correction 117:483, Oct. 1, 1936.

Map Makers and Map Users; Need for National Mapping Program. W. Bowie. With illus. Civil Engineering, 7:273, April, 1937.

Methods Used in a Geographic Survey of Denver. H. S. Senseney. With diagrams. Public Works, 68:36, July, 1937.

Rectification of the Rio Grande; and Other Engineering Work of the International Boundary Commission, U. S. and Mexico; with Cost Data. L. M. Lawson. Civil Engineering, 7:460, July, 1937.

Resurvey of University of Texas Lands. F. F. Friend. With illus. and map. Civil Engineering, 7:507, July, 1937.

Slope Chaining in the Mountains. A. M. Ackerblad. Engineering News-Record, 117:573, Oct. 22, 1936. Correction 117:904, Dec. 24, 1936.

Summer Surveying Camps and Schools in the United States and Canada. O. S. Zeiner. Journal of Engineering Education, 27:614, Discussion 625, April, 1937.

Surveying Teachers Set Courses; First Surveying Teachers' Conference. Engineering News-Record, 119:334, Aug. 26, 1937.

Surveyors' Field-Note Forms. C. E. Bardsley and E. W. Carlton. 113pp., $1, International Textbook Co., Scranton, Pa., 1936.

Unusual Summer Surveying Camp; College of the City of New York Conducts its Surveying Field Work in Van Cortlandt Park. R. E. Goodwin. With illus. Civil Engineering, 7:809, Nov., 1937.

SURVEYING—AERIAL: Aerial Survey is Essential in Modern Oil Operations. L. G. E. Bignell. With illus. Oil and Gas Journal, 37:70, May 20, 1937.

L'emploi de L'avion pour les Recherchez Géologiques et Minières dans les Pays Neufs. F. Blondel. With illus. Génie Civil, 109:545, Dec. 31, 1936.

Progress in Air Surveys. Engineering (London), 144:24, July 2, 1937.

SURVEYING INSTRUMENTS: Cook, Troughton and Simms Theodolite. With illus. Engineer (London), 163:545, May 7, 1937.

Design for Stadia Rod. G. Dinsmoor. With diagram. Engineering News-Record, 119:74, July 8, 1937.

Using the Engineer's Transit to Determine Orifice Coefficients. T. D. Smith. With diagrams. Engineering News-Record, 118:717, May 13, 1937.

TOPOGRAPHICAL MAPS: Declivity Maps; Construction from Topographic Maps. F. E. Masten. With diagrams. Science, 85:320, March 26, 1937.

Field Plotting and Stadia Topography Give Speed and Accuracy; Topo-table Drawing Board. P. Van Buskirk. With illus. Engineering News-Record, 118:564, April 15, 1937.

Map Program Given Congress. Engineering News-Record, 118:280, Feb. 18, 1937.

TRIANGULATION: First and Second Order Triangulation and Traverse in California (1927 Datum). H. C. Mitchell. 548pp. Washington, D. C., 1936. U. S. Coast and Geodetic Survey.

First and Second Order Triangulation and Traverse in Minnesota (1927 Datum). W. F. Reynolds. 411pp. Washington, D. C., 1936. U. S. Coast and Geodetic Survey.

Readjustment of Triangulation Datum. J. L. Speert. Am. Soc. C. E. Proceedings, 63:883, May, 1937.

Triangulation Along the Mississippi River, New Orleans to the Delta. 320pp. Washington, D. C., 1937. U. S. Coast and Geodetic Survey.

Public Works Personnel Problems

A Panel Discussion

CHAIRMAN WEAVER: This is a panel discussion of public works personnel problems. The members of this panel are as follows: E. L. KNEBES, Assistant City Engineer, Milwaukee, Wisconsin; FREDERICK T. PAUL, City Engineer, Minneapolis, Minnesota; ROLLAND D. SEVERY, Little Rock, Arkansas, Public Administration Service and now attached to the State of Arkansas Personnel Division; CHARLES S. SHAUGHNESSY, Chief Examiner of the Civil Service Commission of Philadelphia, Pennsylvania.

I believe everybody knows that it is convenient and useful to have a competent personnel in a public service. Certainly all of us have studied and struggled with that problem, and maybe some of us have successfully handled it. I don't know about that, but I know that I have not.

Andrew Jackson in his first message to Congress said, "The duties of all public officers are, or at least admit of being made, so plain and simple that men of intelligence may readily qualify themselves for their performance; and I cannot but believe that more is lost by the long continuance of men in office than is generally to be gained by their experience."

But, the situation is a little different now. I think that as a matter of fact it may be completely turned around. I know of a great many instances where the public service has demanded men of such caliber that private enterprise has taken them away from the public service after they had been developed for that particular service. They had become outstanding men in efficient management or for some other reason.

As time goes on, we see more and more problems coming before the government. We must have better personnel—there is no doubt about that. It has been stated that if democracy continues to maintain an incompetent personnel, it will probably be forced into a decline. That may be a pretty strong statement, but considering the many duties now entrusted to public servants, there may be a good deal of truth in it. The spoils system dictated appointments and promotions on the basis of service to the party. This practice became such a destructive influence that civil service sprang up nearly a hundred years ago, having as its objective the defeat

of the spoils system. But it frequently so effectively insulated the public employees that they at times forgot their obligation to function efficiently and responsibly in the service of the public.

And, it might be said that some civil service employees are neither civil nor serviceable. Naturally, this has not raised the respect for civil service in the minds of efficient administrators who are anxious to get a job done.

That looks like a rather dark picture, but I believe it is far from gloomy. I think there is a great opportunity in personnel management. We are apparently just getting to the point where we can do something about it. It would not surprise me if this discussion would bring out a great deal about the merit system as distinguished from the so-called civil service. We should have a merit system in civil service wherein the basis for appointment and tenure and advancement is merit, and dismissal is perfectly possible and straightforward when service is not meritorious.

A well developed and well administered merit system will probably lead, as it has in foreign countries, to a career service, wherein a young man may expect to enter the public service, be regarded as a member of an honorable profession, may expect to be promoted from time to time as his experience and ability qualify him, and to continue in that service throughout his useful life. That is a condition and a type of service that is quite prevalent in England and other European countries.

In England, for example, an engineer is promoted up through the ranks of his particular city, depending on his qualifications, and when he has reached the top in that city, he may be promoted to some other larger city. There is not the barrier between cities that we have, so that a man with ability can get places. It offers him a real opportunity and it also improves the public service considerably.

Within the last year, Arkansas has enacted a personnel statute and they have been setting up a personnel system. It is quite a model system and we have with us Mr. Rolland D. Severy who is attached to the staff of the organization which is assisting them in setting that up. Perhaps Mr. Severy will tell us something about that system.

Mr. Severy: In discussing the merit system as a goal and to distinguish it from civil service, let us analyze the history of civil service and the general desirable objectives of the merit system.

Civil service was originally devised to eliminate the spoils system. The thought was that if persons could be inducted into governmental service on the basis of competitive examination of their ability and knowledge, the service would automatically benefit thereby. Both employment and firing were to be removed from the power of the spoilsman. It was believed that a vastly improved governmental service would naturally follow.

The history of civil service has demonstrated that there are certain inherent difficulties in such a simple program. It was found, among other things, that it was not sufficient merely to induct people into the service and guarantee them permanent tenure of office. A most natural human tendency demonstrated itself in the fact that security bred arrogance and the feeling that under no circumstances could the employee be removed. In dealing with only entrance and exit, the working life of employees was largely overlooked.

In consideration of a merit system it will be well to analyze the general objectives. Merit should be emphasized in the original competition for entrance in the service, and merit should include development of an orderly plan for promotion, salary increase, transfer, etc. It should provide standards of equal pay for equal work. Separation of incompetent or unsatisfactory employees should be accomplished with an absolute minimum of difficulty. Training of apprentices and in-service training should be developed to a high degree.

When we turn fully to the positive side and develop those factors which will advance career service, most of the difficulties in civil service will vanish.

It is true that careers have been made under the restrictions of a civil service which does not provide for orderly transfer or promotion based on merit. Careers have been made in spite of a spoils system. If we analyze the reasons we will find the factors emphasized in a merit system. Employees through self training have made themselves so valuable that new administrations could not operate without them. The career men possess a fund of knowledge necessary to the continued operation of a department or service. In your veteran awards you recognize and encourage career service.

In the installation of the merit system in Arkansas we have found a number of departments in which men have made them-

selves so valuable that they have developed professional standards of work and have withstood political storms over a period of years. It is the objective of the merit system to intensify service value throughout government in clerical trades as well as in professional fields.

To accomplish this end our ideas of civil service need overhauling. A governmental career should no longer mean a permanent meal ticket. It should provide an opportunity for an employee to contribute every bit of energy, initiative, and resourcefulness at his command and to receive in return a just recognition. He should be allowed to advance as his abilities alone demonstrate. And, his career must give him prestige in his community.

Prestige can be built up only through the elimination of incompetents from the service. Higher standards of recruiting, a freer recognition of ability, more adequate compensation, particularly in the higher brackets, and positive assistance to supervisors in the elimination of unsatisfactory employees will contribute toward building this prestige.

In developing a revised concept of the civil service, recruiting and examination should continue to receive considerable attention. Standards should be raised. Residence requirements should be carefully analyzed. Where it is found that the service would otherwise suffer the "local boy" complex will have to be broken down.

Wider publicity on public employment is necessary. But, in order really to sell government service it must be made more attractive in many respects.

One of the most immediate and important factors is the development of an orderly system of promotion based on merit. Nothing will contribute as much as the assurance that effort and growth will be rewarded on an impartial basis. Nothing destroys morale more completely than inequitable promotions.

Public administrators have been willing for the most part to allow employees to handle their own individual training problems in a rugged individualistic style. We are now coming to realize that training should be recognized and required at three levels. First, better use should be made of background training before entrance into the service. Second, employees should be trained on the job in their duties and in related activities. And third, general training should be offered to keep employees conversant with new

developments and techniques and to qualify them for higher positions.

Salary and wage plans must be developed which will follow the principle of equal pay for equal work, and which will consider costs of living and competition with private industry. We have found that at certain levels the salaries paid in public service greatly exceed those paid in private business while at other levels it is impossible to find adequately qualified persons who will accept the offered salaries.

One of the greatest difficulties in the existing civil service setup involves the natural reluctance of supervisors to defend the removal of incompetents. The power of reinstatement granted civil service boards or other bodies invariably weakens the position of administrators, creates permanent problems with reinstated employees, and destroys the spirit of an entire service. This situation may be met by granting the administrator the power of dismissal and removing from boards the power of reinstatement except in such cases as are definitely shown to have been caused by religious, political, or other class reasons.

The setting up and operation of a satisfactory personnel program is dependent on the complete cooperation between departmental administrators and the personnel officer or agency. A little later there will be a discussion of the methods of establishing merit in local government. Whatever that method be it cannot achieve its objectives without the aid and guidance of departmental administrators in recruiting, training, improvement of working conditions, discipline and other problems. It is certain that for the success of a personnel program the true position of a personnel man should be to act as a consultant rather than as a line official imposing himself in the path of administration.

CHAIRMAN WEAVER: Have you any comments to make on that presentation?

MR. SHAUGHNESSY: I am glad Mr. Severy brought out the distinction between civil service and the merit system. It seems to me that much of the confusion we are encountering today in public service has been due to the lack of understanding as to what the merit system is.

Of course, the term "civil service" is a misnomer and should not be used to picture the machinery for selecting people for public service. It is an outgrowth of the old civil service reform move-

ment when the need for reforming the public service came into being. Of course, you know the word "reform" was tacked on to the expression "civil service."

Civil service is simply an expression to distinguish a certain body of people from the military service or the naval service or any other kind of service. It has nothing whatever to do with the machinery that is used to select people. And, public opinion has a lot to do with the kind of people that we get. I must confess that the entrants to our public service have not been as good as we would like to have them and the quality has been declining for some years. I believe that some of the reasons for this will be brought out today.

Mr. Severy also mentioned the necessity of attracting the right kind of people to the public service. Neither from an educational standpoint nor from an experience standpoint have we been successful in getting these people. Sometimes it is due to a political consideration, sometimes it is a career service that is lacking, and sometimes it is a matter of salary, but whatever it is unless something is done to improve that attraction, I fear we are going to come to the situation that our chairman has mentioned, that of endangering the institution that we call democracy.

CHAIRMAN WEAVER: What is your experience on that, Mr. Paul?

MR. PAUL: I am afraid that I don't see this picture as dark as Mr. Shaughnessy does. Our experience in Minneapolis where we have the combination of municipal pension and civil service law, leads me to the belief that we are getting very high-grade people in our civil service. I believe the people we have working for the city are high grade and as good as you can find in any industry in the city. I know this to be true because we have a little different system in Minneapolis for our public works. We do all construction work by day labor and the cost of that work as compared with contract work in that district is very favorable. If we were not getting a high grade of employees that would not be true.

I think one reason for that is our pension system which is no doubt a real incentive for a little better quality of work. People have more interest in their job and will do better work if they have a permanent setup which no political party can take away from them.

The employees contribute to the system and the pension amounts to enough to support them when they reach the retiring age. I

am sorry I have to differ from one of the members of the panel but that is our situation.

CHAIRMAN WEAVER: What about Milwaukee?

MR. KNEBES: I certainly agree with the comments of Mr. Paul. I believe that we are getting a better grade of employees now than ever before. About a year ago I was discussing this subject with several officials of our city, and I said that the time would come when university graduates would be taking examinations for positions under civil service. Because of the depression, we have not had very many examinations, but just recently it was necessary to fill a Rodman's position, and the first three men on the list that was submitted to the head of the department were university graduates. I think that is proof that the personnel in municipal service is improving.

MR. SHAUGHNESSY: Are you referring to depression times or normal times?

MR. KNEBES: To normal times.

CHAIRMAN WEAVER: Perhaps you more closely approach the merit system than other places.

MR. KNEBES: I think you are correct there. At the present time we are inaugurating a pension system in Milwaukee. It is supposed to go into effect the first of the year, and I think the remarks of Mr. Paul will apply to Milwaukee equally as well as to Minneapolis. I think the pension system will induce the city employees to be more careful and do their work better, and try to remain in the service long enough to obtain the pension.

MR. SHAUGHNESSY: Have you any figures as to how those who compete in your examinations classify as to education?

MR. KNEBES: Of course, a great deal depends upon the type of examination that is being given. In the case of the Rodman's examination, the candidates were required to have a high school education or better, but the high school graduates no longer have a chance. There are usually certain age limits which may eliminate many of the practical men, but I believe that is a good thing. In my opinion it is not very desirable to have a man, who has been working as a Rodman for thirty or forty years, working under the direction of an engineer who is about thirty years of age. I think the restrictions are for the good of the service, but I have no definite figures on educational classification.

MR. SHAUGHNESSY: In Philadelphia after several years the per-

centages have been running something like this in the service generally: About 64 per cent of all those taking examinations have nothing better than a common school education, about 20 per cent graduated from high school, and 16 per cent have been to college, but some of them did not graduate. That includes the professional service too. That is the basis upon which I remarked that the character of the entrants is declining.

CHAIRMAN WEAVER: How are you setting up the procedure for the removal of incompetents in Arkansas?

MR. SEVERY: This setup is rather unusual. I don't know of many jurisdictions where it has been followed. The department heads have the sole authority to fire incompetents. The employee cannot be reinstated by the Civil Service Commission or by any other authority. He is entitled to present his case to the Personnel Director who has as a major duty the investigation of all cases of dismissal. If it appears from the investigation that the employee has been removed for political or religious reasons, the employee is then advised by the Personnel Director to present the case in open hearing before the Civil Service Commission. Then, if it is found that the removal was for either of those causes, the employee may be reinstated.

However, under any circumstances, a reinstatement breaks down the authority of the supervisor and makes him lose face with his employees.

Now, the possibility arises that a department head will come down with a sour stomach some morning and, feeling that way, he may fire an employee. Well, when that case is reviewed by the Personnel Director, the Director then goes back to the department head and tries to convince him of the folly of that particular action. If that cannot be done, there still is the possibility of an open hearing, at which the reporters and the public are invited to be present. The department head is then out on a limb, but he still does not have to live with that particular employee.

That briefly is the setup, and that particular type of action is recommended by the Civil Service Assembly. That is the way we are going to handle it and we believe that it will work out satisfactorily.

CHAIRMAN WEAVER: That seems to me to be a forward stride in personnel management. What do you think of that, Mr. Paul?

MR. PAUL: I think that is a very ideal condition if it is possible

to work it out. Unfortunately we do not have it in Minneapolis. Frequently men are reinstated, out of sympathy, I think, where they had been discharged for reasons other than those mentioned. Possibly during the depression there was more or less justification for that sort of action, but I feel as Mr. Severy does that your department head certainly does lose face if he fires a man for habitual drunkenness after he has given him all the chances in the world, and then the man is reinstated. The department head not only loses face with that man but with all the rest of the department.

CHAIRMAN WEAVER: What about you?

MR. KNEBES: Our condition in Milwaukee is similar to what Mr. Paul mentioned. It certainly would be a step in the right direction if the right of appeal could be taken away from the Commission, and a method instituted similar to what Mr. Severy explained. But I will say this: Our Commission in Milwaukee has looked very favorably upon the recommendations of the department heads in many instances. I know of several cases where men have been fired, appeals have been made, but they were not reinstated. I think you will find that when a man is reinstated some politician has interceded and has prevailed upon the Commission or the department head. I don't say that in any derogatory manner toward any alderman (we have some with us from Minneapolis) or anybody else, but those are the facts. If we can get away from that, I think it will help the service tremendously.

CHAIRMAN WEAVER: Do you think that is workable?

MR. SHAUGHNESSY: I am glad that you mentioned politicians, because I thought that Philadelphia was the only place that had them. In our city we do not have the right of appeal. When a department head contemplates dismissing an employee he files charges with the Commission and if those charges are based upon certain facts that do not involve religion or politics, they are filed and the man is permitted to answer them. Within five days the department head can fire him. We do not step into the picture at all.

In other words the department head has complete freedom in firing a man provided he files charges as to his reasons. That is done so that the public can scrutinize the charges, but there is no appeal under the law.

MR. SEVERY: Can't the Commission reinstate a discharged man?

MR. SHAUGHNESSY: No.

CHAIRMAN WEAVER: Do you think that the promotional system works out effectively in producing a high type of personnel?

MR. PAUL: Yes, I do. Our Commission for a number of years has followed the idea of promotional examinations with the exception of a few specialized positions where there was no one already in the service capable of handling that particular job.

In Minneapolis, we feel that the promotional system is one of the best preservers of morale that we have. Most of our examinations are promotional examinations. It gives the employees something to look forward to and work for.

CHAIRMAN WEAVER: Do you find any defects in that?

MR. KNEBES: No, I don't believe there are any. There is no question in my mind that a man in the service should be promoted if he has filled his previous positions in a satisfactory manner and has passed a promotional examination. I believe the preference given to veterans under some systems is wrong. In Milwaukee it is not as unfair as it is in some other jurisdictions. In our city a veteran only receives five additional points, and this gives him only a slight advantage over other candidates.

CHAIRMAN WEAVER: Do you contemplate providing for an organized promotional system in Arkansas?

MR. SEVERY: Yes. That is very definitely provided for, but in addition there are a few other factors taken into consideration. If it is definitely decided that the person who comes up for a promotional examination does not meet the desires and standards set up, the position then must be thrown open to the public for new blood.

Obviously there are certain people in a community who can't hope to meet the requirements wanted for a particular position, even though they may be in line. The promotional setup will be used in Arkansas, but it will be modified by the requirements of the best possible service.

Another factor is the resident requirement. There may not be a person in the local jurisdiction who can qualify, and if not, then it is necessary to turn not only to a competitive examination, but one which a non-resident may be permitted to take.

CHAIRMAN WEAVER: What is your system?

MR. SHAUGHNESSY: We have a promotional system in Philadelphia, but I don't think we promote as many people as we should. That is, I don't think the opportunities for promotion are as ex-

tensive as they ought to be. We have, for example, a great number of engineers who have been in blind alleys for years and to whom the opportunity of promotion has been denied because we do not have a sound logical classification. The line of promotion has not been established and rigidly adhered to, and as a result a man going into the service cannot tell where he is going to meet the blind alley. He should be able to see a picture of advancement, such as we see in the fire and police departments. In any of our cities, a man going in as patrolman can see the possibility of becoming the Superintendent of Police.

I don't think the engineer in our large cities can see that progression, but he should be able to. Now, I don't mean to say that we should not bring in timber from the outside, and perhaps we should try to make the service more vigorous, but I do think we are leaning the other way too strongly.

CHAIRMAN WEAVER: I think there are times when there is a tendency to carry the promotional program too far. You can't do it with football coaches or with some other positions.

What are the possibilities for developing in-service training in public works? Can that be done?

MR. KNEBES: I believe that in-service training is necessary for the successful operation of any department. I think it will assist and encourage employees to improve themselves, and they will thereby be better able to pass promotional examinations. Most of our city departments have it in some form or another, but I think there should be more of it between departments.

For instance, in Milwaukee, the City Engineering Department, in designing a pavement, may lay out some safety islands or loading zones at an intersection. Later it is found necessary to control traffic at that intersection by automatic regulators which are installed by the Bureau of Electrical Service. The two departments should be acquainted with each other's problems so that when the work is completed it will be a good workable unit.

When the Sewerage Commission in Milwaukee was doing a great deal of construction work and, therefore, employed a large number of men, Mr. Hatton, the Chief Engineer, always held a staff meeting once a month. This was in-service training. We have semi-monthly meetings in our department during the winter months, at which time we discuss our problems. We usually determine what the subject for discussion will be for the next meet-

ing, and if some other department is interested, we invite them to send a representative to take part in the discussion.

For example, we discussed the subject of courtesy at one of our meetings. That may not sound important, but it is. I don't suppose there is a man here that hasn't received complaints about some employee's being discourteous. I have often heard people say that they tried to get some information at the City Hall, and the party that they talked to wouldn't even give them a civil answer. Usually these complaints are greatly exaggerated, but if a citizen is peeved it is better to smile and not argue with him or her. I think the public utilities have gone a long way in teaching and instructing their employees to be courteous no matter how angry or abusive the patron may become.

A great deal can be accomplished by in-service training of this nature.

CHAIRMAN WEAVER: Do you have any particular form of in-service training, or is it like the training an apprentice mechanic gets—learning his trade from observation.

MR. KNEBES: That is the principal method, observation and discussion. We do not have any specified training regulations.

CHAIRMAN WEAVER: Mr. Paul, do you have any in-service training program that is prepared in a specified form?

MR. PAUL: No, I don't see how you can have such a program without bringing in outside experts.

CHAIRMAN WEAVER: Do you have any plans of that kind, Mr. Shaughnessy?

MR. SHAUGHNESSY: We made rather comprehensive plans for training in the service and tried to couple them up with the educational institutions. I think the possibilities of that sort of program are very great. If the educational institutions have men who can teach certain subjects pertaining to the public service and we are able to get them, we could have them work out a comprehensive program whereby our lower grade employees will be trained not only for a promotional position, but for improvement in their present position. I think such a plan was used very successfully in New York about twenty years ago. In cooperation with the Civil Service Commission there and other city departments they developed a very fine plan for training city employees.

CHAIRMAN WEAVER: Mr. Severy, do you have any plans for such training in Arkansas?

Mr. Severy: There is nothing in operation at present, but in recruiting personnel for the public welfare department, it was necessary to take people having an inadequate conception of social work, and the only way those people could be put on the job was to plan the institution of a training program. This consists largely of the conference method, as well as lectures to get across the ideas and the standards desired.

Mr. Knebes: I think the Extension Division of the University of Wisconsin just this past month has established two short courses on public service, but they pertain mostly to city management and city finance. I don't know how successful they will be. It is something new they are trying out.

Chairman Weaver: We have some agencies that have been training police and firemen for a number of years. The average citizen feels that the attitude of the garbage collector or the meter reader reflects the attitude of the city. I feel that we all realize the need of training these people to reflect the proper attitude. They are the ones who are in a position to sell or unsell the city as they are the ones who contact the public. That is the problem of public relations training and it has nothing at all to do with the efficiency of their operation.

I think this question ought to raise some argument: What do you think about the advisability of the head of the public works department being under civil service?

Mr. Shaughnessy: That is a controversial subject and I am going to approach it rather delicately. It seems to me something can be said on both sides. In the first place, civil service administrators have improved their technique a good deal in recent years. They have been successful in a great number of cases in selecting, or enabling the department head to select, the best person for high-grade positions.

Of course, we all want the best men we can possibly get as directors of public works, because they are mighty important individuals, and the question is, can we get them with the machinery set up by the merit system. I feel that with the improved methods of selecting we can do that.

I do not see why this body of engineers could not operate as a Civil Service Commission; that is, to pick out the best man obtainable for a public works job, his selection to be based on his achievements as one factor. If he were selected on that basis nobody could

complain. In that way we would be able to reach some of the high-grade people we desire for public service.

On the other side of the picture, we may have a chief executive selected on a certain program who will tell you that he wants to pick a certain director himself, because he thinks that he can do a better job than the Civil Service Commission. He knows the man, he has confidence in him, and he thinks he ought to be allowed to select him.

Let us look at the record: It seems to me in a great majority of the cases that is the way it is handled and the selections are usually bad. I don't want to give you the impression that everything is bad in Philadelphia, but some of these selections by the executive have been very unfortunate and I am very sure that the method I have outlined for picking a man by the merit system would give us a much better result.

CHAIRMAN WEAVER: What is your thought on that?

MR. SEVERY: I think it depends upon the position of the public works head—whether he is a policy-forming official tied up closely with the administration, or whether on the other hand he is to carry on a program and an organization. It seems to me that there should be a permanent career man in charge of the technical organization to utilize and keep available a body of knowledge and experience.

So, I am straddling the issue, dependent on whether the department head is a policy-making officer.

CHAIRMAN WEAVER: Isn't almost any efficient department head to a certain degree a policy-making officer?

MR. SEVERY: Yes, I suppose he is. Either that or he influences policy making.

CHAIRMAN WEAVER: Well, when he influences policy making, what about that?

MR. SEVERY: Where he is in position to run contrary to the objectives of a particular administration, I wonder how actually democratic that situation would be. We can perhaps point out cases in Washington of a bureau chief under civil service who goes contrary to the Administration. That may not be an actual case, but it is at any rate hypothetical, and such a man can influence the policy of the administration, or he can hamstring it.

MR. SHAUGHNESSY: A policy-forming individual is a sort of vague term to us in Philadelphia. We never find a bureau chief running

contrary to the chief executive's policy because they all determine to help him in his policy. I don't see why any public official who gets his salary from the public fund should not do his job the way it should be done. Sometimes he does differ from the chief executive and perhaps it is a good thing that he does.

CHAIRMAN WEAVER: Perhaps this system of removal from the service would eliminate the problem of a department head under civil service running counter to the policy of the policy-forming group. That might be an argument for that head's being under civil service or in the merit system.

MR. PAUL: I am out on a limb in discussing this question inasmuch as I am under the system. In Minneapolis the policy of the public works division is fixed by the City Council and not by the Mayor, and I agree with Mr. Severy that so long as the administrative heads of the departments of public works do not participate in fixing policies, then the job should depend upon the merit system.

MR. SHAUGHNESSY: Could you give an example of fixing a policy? I should like to get that clear.

MR. PAUL: That is not so difficult. You might have a liberal policy of favoring a high scale of wages, or the policy of doing your work by contract as against doing the work by day labor. Those are definite policies of an administration that should be fixed. In our case our City Council fixes them. There are many other policies also.

CHAIRMAN WEAVER: How is it handled in Milwaukee?

MR. KNEBES: We have been very fortunate in Milwaukee in having a Commissioner of Public Works who has come up from the ranks. He is a very capable engineer and I don't think that he really has much to do with policy forming. I would say that that was controlled more by the Council than the Mayor. Of course, the Council establishes the minimum wages and they naturally fix the budget and the amount of money that should be spent for the various types of work, and from that time on it is up to the Commissioner to spend that money as economically as he possibly can.

Of course, our charter makes certain regulations. For instance, the local alderman and the Commissioner must agree as to the type of pavement. I just mention that, and I suppose every city has some charter regulation, so the Commissioner of Public Works can't always use his own discretion entirely. It is a rather delicate problem.

I had one alderman tell me a few years ago that the Council should fix the policy and have nothing to do with the spending of the money after that. I often wish that were so.

MR. W. A. HEIMBUECHER (University City, Mo.): I am a city engineer and I have found that the best policy for the city engineer is not to be too cocky about his policies. For instance, quite often I found that the merit board had a certain policy that they wanted to put through which I knew was all wrong. I would simply advance my ideas as to why I thought it would be better if they would adopt some other policy. Sometimes they would agree with me and sometimes they would not. Also, I often had some idea that I wanted to get through and would be near-sighted on the question, and they would set me straight.

So, Mr. Chairman, my idea is that a Director of Public Works, if he can work in harmony with his aldermen or Commissioner and discuss the policies before they are actually put into execution, will obtain results that will satisfy the taxpayer far better than doing it in some other way. I happen to be bull-headed on that subject.

CHAIRMAN WEAVER: Obviously a department head, if he is any good, must help formulate policy. His experience with the carrying out of policies proposed by the governmental body places him in the position to know better how to advise on those matters.

I am inclined to believe that the department head might well be under civil service or whatever you want to call it, but with the stipulation that he can be removed if he does try to frustrate policy.

One more question. How can a career service be developed in local government?

MR. SHAUGHNESSY: I think we have touched upon some of the elements in that question already. One of the elements we have not touched upon, and it is important, is the matter of compensation. I think our public servants in the lower brackets are paid adequately, but when we come up to the supervising grades the salaries are too low. I think that fact is very strongly interfering with the career service. There are certain lines of demarcation where we find people leaving the service, and that is the line where these salaries in the main show a tendency to decline relatively as compared to salaries outside the service.

That is true in all of our cities, and the report of the President's Committee on Administrative Management, speaking about the compensation of higher grades remarked as follows:

"Salary limitations of this kind in the higher grades must be lifted, or they will defeat the development of the service. The most promising and gifted people do not apply for competitive entrance to the service because the top salaries are too low. At this moment some of the ablest men are leaving the service as opportunities turn up outside."

In the last year we have had at least sixteen or eighteen men leave the Philadelphia service for that very reason. Of course, they were men interested in their work, but they came to a point where the attraction on the outside was very remunerative and they left the service.

I think that is about the only item we have not touched upon. We have touched upon classifications as necessary factors and also in-service training and equitable promotion systems as necessary elements in career service.

CHAIRMAN WEAVER: Have you any comments you would like to make, Mr. Paul?

MR. PAUL: Just this comment: I think our civil service laws would be much better administered if the administration were placed under the head of one man. Make him a division head of the city government and concentrate the responsibility for the administration of the civil service laws under him. I think that system would be a real improvement.

CHAIRMAN WEAVER: Whom would he report to and be responsible to?

MR. PAUL: To the Commission. He could act as secretary of the Commission. He would be the one to administer the laws and rules and regulations. I think that would fit in very nicely with what Mr. Severy said a little while ago. He could act as the personnel director.

CHAIRMAN WEAVER: I suppose that you are referring to the Civil Service Commission?

MR. PAUL: Yes. The body handling the administration of any civil service law, or if you wanted to you could make it a merit law. There is too much opportunity to pass the buck when you have three, four, or five commissioners, and you don't get any place.

CHAIRMAN WEAVER: Have you anything to add?

MR. KNEBES: I think we would do well to try to strengthen our civil service laws along the lines which Mr. Paul mentioned. You can retain the Civil Service Commission, but I agree with Mr. Paul that there should be one man handling the personnel end of it and

reporting to the Commission. Make your laws strong enough so that the Commission cannot override him, and then he will have the final say. That is the only way that you will ever accomplish the merit system in municipal, state, and federal governments.

CHAIRMAN WEAVER: How can you stay within democratic principle and not make it possible for the Commission to override the administrator's ruling on certain occasions?

MR. SHAUGHNESSY: That is a good point. In fact we had a bill introduced in the legislature and that point was raised. The personnel director was to be given complete charge, and there was a strong protest on the part of the state senators that the law would take the whole civil service merit system out of the hands of the public. It therefore would not be a democratic instrument. There was a compromise on that which admitted the possibility of overruling the personnel director at times, but the record of that overruling by the three Commissioners would be entered on the minutes and be made a matter of record. It was thought that this plan would be a good check on any abuse of power on the part of the Commission.

MR. KNEBES: Won't that be accomplished by having open hearings of cases like that? Something similar to what Mr. Severy mentioned in his opening remarks.

MR. SHAUGHNESSY: It might and it might not. I don't know whether the open hearings accomplish as much as we think they do. They bring out a lot of discussion, but we have public hearings which we think are going to prevent the department head from making some unreasonable demand, but it does not have that effect. It does not work out as we thought that it would.

MR. PAUL: The idea I was trying to express was that these Civil Service Commissioners are being appointed by the mayor, and are frequently business men with very little knowledge and experience in the administration of any department. Our idea was to have one man responsible to the Commission, with the Commission acting as the policy-forming body for setting up the rules and regulations, and to interpret any of the rules where there is a controversy. But, the actual administration of those rules should be under one responsible head—a well-paid head, a man with intelligence, experience, someone the other departments would have complete confidence in, and one who would not be in a position to play politics to retain his job. That is what I was trying to bring out.

MR. SEVERY: My thought is that in no case should the adminis-

trator be put into a dictatorial position. He should be an administrator. The Commission, on the other hand, should not be put into the position of administering with the power to watch details. It should be the watch-dog of the civil service, but should not actually administer the service. There should be just one man responsible for administration, and then the Commission can check on him.

CHAIRMAN WEAVER: I believe that we have had sufficient discussion on these problems and now I am going to throw the meeting open for general discussion.

MR. F. T. THORPE (Philadelphia, Pa.): I would like to ask Mr. Knebes a question in regard to the distinction between university graduates and self-trained men having a wide practical experience and holding a state license. Is there any distinction between the licensed engineer and the university-trained applicant so far as taking the examination is concerned? Are they considered on a par or not?

MR. KNEBES: No, the licensed, registered engineer is not looked upon in the same light as a person who has a university training. However, all of the examinations of an engineering nature now require, up to a certain position, that the applicant be a licensed engineer.

MR. THORPE: It strikes me as rather odd that you should favor the university graduate over the registered engineer who has some practical experience in the field and who is usually more efficient than a recent graduate.

MR. KNEBES: You are correct there, but I think you will find that many of the practical men who hold state licenses would still fall down on the written part of the examination.

MR. THORPE: That is not the point I am driving at. If a man holding a state license takes the same examination as is taken by a university graduate and the two of them receive the same mark on their papers, would the fact that he is not a university graduate interfere with his selection?

MR. KNEBES: No, their chances would be equal.

MR. THORPE: I never went to a university although I have a registered engineer's license. I have never taken any civil service tests and I do not hold any degrees as a civil engineer. I just wondered if I had taken your examination and received a higher mark than the other fellow who was a university graduate, if there would be any distinction shown. If there were, then I would not regard that as a very fair board.

Mr. P. Hansen (Chicago, Ill.): I have listened with a great deal of interest to this discussion and I think it has been remarkably well covered. However, as I listened, it struck me that we might have to get ourselves better oriented to our objectives, if we are to adopt and emphasize the phrase "trained civil service." Persons should be trained before they become civil servants and they should continue their training after they are in civil service, to prepare themselves for enlarged responsibilities. And, those civil servants should be accorded a hearing on every question that comes up, but the question of determining policy, making decisions, etc., in regard to expenditures should be in the hands of the elected officials in a democracy such as ours.

With reference to the discussion of training civil servants already on the job, the City of New York recently dedicated a building and an institution for the purpose of giving civil employes an opportunity to receive training by an instructional staff of the University of New York.

Chairman Weaver: Mr. Cleary, assistant editor of the *Engineering News Record,* is in the audience. He, no doubt, has taken some notes on the discussion for his guidance in preparing an article. I wonder if he would give us the benefit of his impressions.

Mr. E. J. Cleary (New York City): This discussion of personnel is apt to be termed the "thorny question." It is a topic we may well consider at this time when there is so much agitation on the labor front regarding employee and employer relationships.

I think the big question confronting us in connection with civil service is how to harmonize existing civil service operation with the idea of unionization. There is a profound movement among professional men, particularly those in the technical fields of engineering, toward unionization activity. Engineers are debating pro and con whether or not to affiliate with unions. While it is too early to forecast what trend this movement is taking, it bears watching.

Incidentally the unionization of municipal professional workers is not new, because I understand in Chicago there is a union of engineers and draftsmen which is affiliated with the American Federation of Labor. Should this movement extend to other cities and become wide spread, it will become far more complex than indicated here today.

I think it has been pointed out in this discussion that personnel administrators are conscious of the need of developing something

more vital out of the present stagnant condition. The government service generally is not held in high repute, but with wider responsibilities taken over by the government, it becomes increasingly important to secure greater efficiency of the personnel. To do that you have to encourage and safeguard the personnel, and the discussion today has dealt with some of the steps that can be taken under the merit system to work out such a safeguard.

Let me briefly summarize the questions that were discussed, and add an opinion or two. The first question: How are incompetents removed from the service under the merit system? I think our discussion here revealed that the Arkansas system of removal of incompetents by taking away their right to appeal is a step toward an ideal. It is a kind of check-and-balance system which will be rather interesting to watch to see how it works out. I don't know if that system is being applied in any other place.

In listening to that discussion, it occurred to me there was considerable difference of opinion regarding the personnel entering public service today. We had expressions from two different cities that disagreed. And, it appeared from the discussion that a pension system is perhaps the inducement to better personnel. That might also mean that the objectives of the merit system are being approached in these cities where the higher caliber of men are being taken into public service. However, in order to cast better light on this question we need a more careful analysis of a number of individual cases before we can jump to any conclusions regarding what is conducive to securing a higher caliber of men.

The second question: Is a promotional system practical? I have in mind a particularly good example of a promotional system—the one in operation in New York City during the last few years, particularly in the Water Department. Last summer I had the privilege of being there when Mr. Goodman, the Chief Engineer, was raised to the position of Commissioner of Water, Gas, and Electricity in New York City. He started in the department thirty-five years ago as a rod man and it was quite thrilling for me to see him achieve that position, as well as to note the advancement of other men in the department. Another man by the name of Patrick Quilty moved up to the position of Chief Engineer, and he told me later that forty years ago he had come to the United States from Ireland, drove a delivery wagon, studied in night school, then got a job in the Water Department and in the course of about thirty-

five years advanced to the position of Chief Engineer. That is a real achievement.

The third question: What are the possibilities for developing training in the public works department? The police and the fire departments have such a system but so far as I know the other departments do not, and that was brought out very definitely. I think it was evident by the discussion of the third question that there are a great many possibilities for training public servants which have not been explored as yet. I know that Public Administration Service is promoting this sort of thing in many parts of the country, and I was going to mention the New York City experiment, but Mr. Hansen has brought that to your attention. However, I think also of such organizations as the American Water Works Association which, in cooperation with state health departments, has been promoting a short school and training course throughout the country.

The state health departments are also interested in promoting the betterment of sewage plant operation, and through the use of short schools and intensive application they have done a splendid job in training their personnel.

The fourth question: Should the public works department head be under the merit system? On this there seems to be a decided difference of opinion, based on, first, the fact that the head of the public works department may be a policy-making individual or a technical director. If he is a technical director, it seems sound to me that that man should develop to that position by means of a career service. I think one thing should be made clear. If we strengthen our professional standards and increase general respect for engineers, there should be less need for competitive examinations.

Mr. Shaughnessy's suggestion is that such factors as achievement, personality, etc., might be the basis of selection. I think that that is a sound idea, and one which is in accord with the ideals of professional dignity. At the present time there is a tremendous impetus toward the improvement of professional standards of engineers, through our registration boards, etc., and I think the time will not be far distant when such professional standards can be established as a common thing.

The last question: How can a career service be developed in local government? I think merely mentioning the elements that have been brought out is sufficient. First, we must provide adequate compensation. Second, we must adopt better classification systems. Third,

in-service training must be encouraged. Fourth, better use should be made of an equitable promotional system.

Mr. Thorpe: Although I do not like to go back to the question of registration, in many of the eastern states where the registration act means something, they are insisting upon the registration seal being used in the design of structures. Only engineers who are qualified as professional engineers and are registered are permitted to place the seal on such papers.

Coming back again to the A.F. of L. and the C.I.O., we have an interest in unionization because practically all men in the technical service were forced to accept drastic reductions running from 10 to 30 per cent. To a certain extent that fact has created a little feeling there. The men are beginning to see some assurance of the return of prosperity and they feel they might be able to get some of their cuts back. Our men formed an organization of their own solely for that purpose, but later on an organizer of the C.I.O. attended one of their meetings and they found it was to their advantage to affiliate with the C.I.O. That will just show you what can be done by people in the labor racket to create a lower ideal of service where the merit system could be improved. In other words, if we would put the merit system in and operate it the way it should be operated, we could keep out the C.I.O.

Mr. P. L. Brockway (Wichita, Kan.): It seems to me that the discussion here today was summed up a long time ago when someone said, "Whatever is best administered is best." That is what appeals to me.

I could not help but be impressed that after you make all these rules and regulations you find holes in them. Then you start plugging up the holes in the structure, and the first thing you know the whole thing gets so complex that you might just as well scrap it and start all over again.

I heard a story a few months ago that is pertinent to the whole question of public service. We were in the midst of a rather heated campaign and of course in such a campaign many very strong statements are made which are not always based on facts. I don't know where the statement started but it came to me third hand that one man very pointedly and heatedly said, "What is the use of paying any attention to what he says? The minute he is elected he will forget everything that he has promised."

Well, a very philosophic answer was made to that. We have a

representative form of government, and these people we elect or appoint are truly representative of the whole structure of our people. Some of them are thoroughly incompetent and the only reason they are in office is because they were put there by some politician. Then there are some who are tolerably crooked, and then there are others who are of high caliber and are doing a fine job. You can say the same thing about any business from the grocery business to the medical profession. They have their incompetents, their crooks, and the people who are high class.

So, the people in our government are truly representative of all the rest of us. I heard the statement made here that only about 16 per cent of those taking particular examinations attended college, but go through any industry and see what percentage you will find that attended college.

The other thing I would like to mention is that the analysis of our membership in the annual report shows only twenty or thirty cities of over one hundred thousand population but that there are something like four or five thousand of the smaller cities—and that is where most of us are. I can understand how larger cities must have more rules and consequently more holes to plug, but such is not the case in the smaller cities. There everyone knows everyone else intimately, or knows someone who knows him and his character and capabilities. It is not very difficult to get all of that information in a small town.

In regard to civil service I would like to say that about twenty or thirty years ago Wichita had a population of sixty thousand and was spending a million dollars a year in public improvements. Then we went over to a form of government which made it mandatory to put everybody on civil service. Well, we worked on that basis very satisfactorily for several years, and then eight years later we went to another form of government, that of city management. We did not use the civil service then because it was contrary to the spirit of the city manager law which holds the manager responsible for all administrative work. We never had any difficulty with that and we have developed a merit system now.

In regard to the in-service training, we have organized a club open only to the heads of departments. At the meetings each department head tells the rest of the heads what his duties are, and in that way we have all become familiar with what the other departments

are doing. We call it our A. B. C. D. meeting or A Better City Department.

There was mentioned here the matter of courtesy. I believe that all public servants from the top to the man who collects the garbage should reflect the character and the ideals of the department head or the city head, and his attitude will tell you whether or not he is an autocrat or a real civil servant. It is just as essential for us to have satisfied customers as for any retail business in the country. The fellow in the street is the one who makes or breaks the reputation of an administration by his attitude.

Now, in regard to the policy-making group. I know that theoretically under our government there is no question that the elective officer is the policy-making man. He is the person responsible to the voters and if he does not respond to the will of the voters then somebody else will. But, at the same time how is the legislator going to satisfy himself entirely unless the technical man and administrator are sitting right in with him? The administrator especially comes to meetings like this and learns of new methods, and it is certainly his duty to go back and make his new information available to the policy-making body. Isn't that the way policies are actually formed throughout the country? You can't draw any line of demarcation between your elected man and employed man, and I think the head of the department of public works is not worth his salt unless he is constantly suggesting, not promoting, the policies that he thinks might be carried out.

Chairman Weaver: What are your views?

Mr. Severy: We have missed the boat entirely if we have implied that the merit system cannot be applied to small cities, but is good only for the large jurisdictions where there is a civil service commission set up. The way we look at it there is no reason why the principles of an orderly system of promotion, adequate compensation, and orderly dismissal procedure in which your city manager stands in back of his department heads, can't be applied in the small jurisdictions as well as they can in the large cities under a civil service commission.

Chairman Weaver: I understand that the Board of Directors have approved a resolution pertaining to the merit system, and I am going to ask Mr. Rosengarten as Chairman of the Resolutions Committee to read it at this time.

MR. ROSENGARTEN: The Resolutions Committee appointed at the early part of this convention, consisting of Mr. Flockhart, Mr. Herring and myself, have given consideration to a number of subjects which might be brought up in the form of a resolution. After reviewing the various subjects I have concluded that one of the most important resolutions is that concerning the subject being discussed this afternoon, and I would like at this time to express my appreciation and congratulate Mr. Weaver and his panel for the excellent manner in which they have presented this subject.

The Resolutions Committee submits the following resolution for your consideration:

"RESOLVED, That the American Public Works Association strongly endorses the adoption of the merit system of personnel administration in government service, including the selection, promotion, and retirement of administrative employees on the basis of merit and hereby authorizes the Board of Directors to cooperate with the governing bodies of other organizations in securing this objective."

I move the adoption of that resolution.

MR. GODAT (New Orleans, La.): I second the motion.

MR. SHAUGHNESSY: I did not hear that last part. Is that just an expression of opinion or do you encourage some kind of action?

MR. ROSENGARTEN: We concluded with the following words, "and hereby authorizes the Board of Directors to cooperate with the governing bodies of other organizations in securing this objective" and we hoped that that would mean real action.

. . . The motion was put to a vote and carried . . .

CHAIRMAN WEAVER: Are there any more questions?

ALDERMAN E. I. HUDSON: (Minneapolis, Minn.): I was interested in your comments on civil service and your merit system, but I want to call your attention to one thing. When you do adopt your system, do not omit the chance of appeal from the man who is discharged for the simple reason that if you do you are going to run up against something in organized labor. Organized labor is coming along very strong in this country and the minute you omit provision for appeal you are liable to have organized labor stepping into the picture and defying you to fire anybody. I would sooner see it as we have it, with a provision for probation for six months, with a chance to appeal to the Board.

I am thoroughly in accord with your sentiment about selecting a

personnel director who would also make an investigation after an employee is laid off so that he could tell the commission the facts when they are hearing a complaint.

I realize, having been a member of organized labor for twenty-five years, what you are going to run up against in the future in other organizations.

MR. SEVERY: I would like to clarify my statement. I did not intend to convey the idea that the employee did not have the right of appeal. He has the right of appeal to the commission and, furthermore, later on to the court if the decision should be unsatisfactory to him. That, no one can deny to him, but the commission does not have the power to reinstate the employee. At that point it is a matter for reinstatement only if the discharge has been on religious or political grounds. The employee has the right to have the whole thing aired and made public and that is the place where the department head is shown up.

MR. HUDSON: Supposing that your commission decides I was discharged without cause, would I go back to work then? If your decision comes down against me I still have the right to go to the court with the issue and you cannot deny me that right, because in this land of democracy we still have that privilege. However, I believe the commission should render a decision as to whether or not I should go back to work. If the commission is not capable of doing that, then the members should not sit as a commission.

MR. SEVERY: That has been the weakness of civil service and will continue to be the weakness—the power of commissions to put people back to work in departments under persons with whom they cannot get along and in a position where that employee can forever thumb his nose at his boss. We feel that it is more important to have the administrator in a position of actual administration.

MR. HUDSON: Well, in regard to that, do we need a new law or another kind of personnel sitting on the commission? If the commission is continually putting back employees who are not getting along with the administrator, then I would say that that reflects on the commission. I think instead of having a law that would reflect on one or the other that we should still strive to get into civil service personnel who really know their business. That is where the fault lies half of the time.

MR. SEVERY: Well, no law will ever be designed to accomplish

both ends. It is a matter of administration just as this gentleman stated a few moments ago—the best administration is that which is actually best administered.

MR. THORPE: In connection with this panel discussion this afternoon, I cannot see where there will be any possible conflict with organized labor. It seems to me that the best protection that can be given to city and public service employees is in the rigid application of the merit system.

MR. W. H. H. OGDEN (Philadelphia, Pa.): I would like to have the privilege of going on record as being very much in favor of the resolution presented by Mr. Rosengarten.

Planning Problems of the Smaller City

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ABOUT a year ago, I made the mistake of telling a group of city planners that the city engineer could function as the city planning engineer. At that time I received the very doubtful compliment, or perhaps it was very polite sarcasm, that I must be an extraordinary person. Apparently, I didn't convince many that the two functions were in close agreement. You can see the fallacy of the doubtful compliment so it seems to be up to me to prove my statement—which I made because I had been filling both functions for five years.

Since there are more city engineers here than planners I may not get much argument on this point. However, I would like to show that the city engineer or the public works director is acting as the planning engineer and must continue to do so for some time, until the universities have ground out a few more men with a degree in city planning and these men have gained their essential years of experience by making just enough mistakes to realize that they do not know what city planning is all about.

First, there are over 3,100 cities in the United States with a population of over 2,500 persons and, of this number, 1,700 or more than one-half are reported by the National Resources Committee

as having planning or zoning accomplishments. More than 1,050 have planning agencies but fewer than 50 provide their planning agencies with sufficient funds to employ a city planner. Of the 918 cities between 10,000 to 200,000 population according to the last census, 658 or almost three-fourths of them had planning agencies or zoning accomplishments to their credit, but only 25 or about 4 per cent provided their planning agencies with sufficient funds for a city planner, so it appears to me that the city engineer is directing the planning work. Furthermore, since the city engineer usually has more to do with putting the plan into effect than any other person, he is best able to see the practical difficulties in carrying it out. He also has to live with it every day. Most city engineers and public works officials lose sight of the general idea for development of the whole city because they are too much absorbed in the particular job before them.

What are their problems? I cannot discuss the more profound social and economic problems which have become more apparent in the last few years. Only the commonplace can be touched upon and those only briefly, although the others are more interesting.

One of the problems appears to be to convince the city fathers that planning is important—important enough to warrant the establishment of a planning agency that doesn't have to beg funds from another department. Planning is not going to get beyond the stages of wishful planning until plans have left the draftsman's board. Planning commissions do not get far unless they have some one to work out their suggestions, and that takes appropriations. Unless you have funds, your planning stagnates. In too many cities, planning has already stagnated. Planning commissions are inactive because they have no one to work out their ideas and carry them beyond the wishful stage. Certainly, the group of smaller cities needs planning as much as the large cities, since all large cities grew from a small beginning.

Planning Must Be Practical

Perhaps we haven't the right idea as to what city planning is. To me, it doesn't mean the City Beautiful nearly as much as it means the City Practical. A practical city will be beautiful because it wears well. People are going to live in it by choice because it is enjoyable and practical. Industries and business want profitable locations, and hesitate to locate where the sewers, water mains,

highways, and other utilities are not adequate. Too much stress has been laid on the aesthetic side of city planning and not enough on the side that affects our pocketbook. Planning commissions are quite often under the wing of the park board and right away they have a handicap. Planning has to live down its aesthetic association. As to functions, a planning commission can just as well plan the city economic program or its complete physical development program as it can the park program. If we talk about the kind of planning which makes it easier on the pocketbook, we are going to have the same chance as everybody else when we come to bat, and won't have two strikes called before a ball is pitched. I think this over-emphasis on the aesthetic is one criticism of planning that must be overcome. When that is done, appropriations are going to be easier to get.

Most planning has cost more money than it should because it was necessarily corrective planning, that is, the undoing of things already done. This is particularly true in the large cities. As the layman judges city planning by its accomplishments, he sees that city planning costs money. Smaller cities are in the fortunate position of being able to avoid most of this expense by planning now for their future needs and acquiring them before they become expensive. If cities really planned, many things now being done would not have to be undone later. Land condemnations would not be necessary to buy back what should have been public land from the start. Practical planning is largely an engineering job.

Today, we need parks and playgrounds. Why? Because the kids do not have any place to play. Tomorrow, we are going to need more jails and penitentiaries. Why? Because the kids didn't have any place to play today. And they are going to cost more than parks today—so why not choose the less expensive?

The Role of Zoning

If we had insisted on proper zoning regulations from the beginning, much of our current difficulty could have been avoided. We have learned that building lots are too small so on new plats we have insisted that they be made larger. Perhaps when they are made large enough to be what we feel is adequate, some one will build a house on each half and defeat our purpose. And there are other ways to defeat the purpose.

Many of us grew up in small towns or on farms that were not overcrowded. Today, few smaller cities are not troubled with some overcrowding. We didn't need the public open spaces then because we had them in our own back yard, and if we had some of that space in our back yard today, there would not be such a crying need for parks and playgrounds with the necessary supervised play. Supervised play costs money, but when the kids can't play in their own back yard, the city has to provide it for them. We would not need to lose our temper on the highways on a week end because of the Sunday drivers nor because the parks were jammed because there would be some measure of enjoyment at home in the space provided, and we could stay off the highway and out of the parks. Our disposition might be much better too, and that is worth something.

Overcrowding is responsible for a lot of our ills and if it can be eliminated we have solved quite a few problems. Persons living in cities must remember that they are living in close proximity with each other, close enough so that it is some concern of theirs if their neighbor keeps pigs in the parlor or starts a machine shop next door. There isn't any need for such overcrowding. If all the families in the United States were housed in single family dwellings on an average lot 50 by 120 feet, and we included an equal amount of land to accommodate business and industrial property, it would take about one-third the area of the State of Georgia to accommodate them comfortably.

Most cities have too much subdivided property, and the market for it hit rock bottom about four years ago. Without definite statistics to prove it, I will venture to say that there is enough subdivided property within present urban boundaries to accommodate more than double the present urban population. I know that in many cities the condition is worse. What can be done with it and how the owner can hope to realize any profit from its sale is beyond me. The assessors know there is too much subdivided property, but it will be a few years before the treasurers know it. That time will come when they have to sell it for taxes. The cities do not want this land to stay idle nor do the owners, but the country is certainly not increasing its population fast enough for the owner of poorly located vacant property to have any hope of its becoming improved for private use within his lifetime. People

that bought it were caught at the old shell game but now they are too stubborn to admit it.

Fortunately for the cities, land prices have not come back to the old level, and two lots can now be bought for what one used to cost. A number of people have been educated to this fact and are buying two lots for one house. Urban land values are still too high. There are still too many people who arrive at the value of land by adding a few dollars to the price of the last sale. They have not yet found out that the purpose for which land can be used has something to do with its value. They haven't realized either that if there are 10,000 other lots exactly alike they probably are all worth the same. Voluntary buying of more than one lot per house is going to help solve the excess land problem and the overcrowding problem at the same time, so two of them could be taken off our hands in this way. If the city told purchasers they had to buy two lots, it would not last; in fact, it isn't lasting now. On the edges of every industrial city, a shanty town is being built up because land costs in the city are too high. For people to move to the edges of the city is not going to increase the value of urban lots. Capital costs must be written down and the depression surely helped there. But sewers, water mains, streets, and other improvements are still where they were optimistically placed to serve a future crowded population which never materialized, so a lot of the money spent for them has gone out the window. It should have been planned differently in the first place—which would all be very fine if we had been able to plan it, but most of this situation was inherited. We will also inherit shanty town some day, which is going to be expensive for our cities.

Since we have the problem on our hands, the next best step is to regulate land use in the cities. There have been a number of cries lately that zoning ordinances are out of date. The answer to this is "yes" and "no." About 85 per cent of them have been written or revised in the last fifteen years, and a zoning ordinance shouldn't get very far out of date in that time. But most of them do not go far enough in trying to remake the city or preserve the status quo in the sections still unspoiled. Most of them should be revised to permit less than half as much land for buildable area as is now used. Then they wouldn't be out of date, but there certainly would be an awful protest.

The public is a selfish animal. We were gullible and bought land

that is and never will be any good, but rather than admit it we will blame the city for it. The city administration takes a lot of blame it does not deserve. Each citizen wants special privileges, but at the same time does not see why his neighbor should have special privileges. Zoning is generally done with the idea of permitting suitable land uses in certain districts, and there is the rub. No one can draw up a zoning ordinance that will suit all the property owners.

Excess of Business Frontage

One very common fault in cities today is due to the fact that subdividers of property wanted to be sure there would be no lack of business frontage, and so they laid out business lots in the ratio of about one business lot for every five residential lots. In some places, this ratio is one to two. Obviously these so-called business lots can never be used for business since the proper ratio lies somewhere between one to fifteen and one to twenty-five. It isn't for the best interest of any city or individual to have unused improved business property. No one profits by it. However, the closer we approach the one to twenty-five ratio, the more will be the protests because there will be persons who still think their so-called business lot is suitable for business and that the reason for their not being able to use it as such is because of the zoning ordinance. This isn't the case, of course, because they didn't have business frontage in the first place. All they had was a 20-foot lot. Traffic going by the door makes business frontage and not the size of the lot.

Some people think that zoning is just a reason for a lot of their headaches, but it does keep beer gardens, gas stations and small machine shops out of residential districts and when it does this, it is worth while. At least some people are not going to have the price of their property depreciated because a few want to take advantage, and there we save some more money in the pocketbook, but not the city's pocketbook this time.

Some cities have had trouble with trailers. In Michigan a trailer has been classified by a local court as a dwelling. If a trailer is a dwelling, and if you have a zoning ordinance, you will not have any trouble, for trailer camps cannot operate profitably when they have to provide the space required for dwellings. The single trailer to my mind is not a nuisance. Less work is required to keep it clean and sanitary than a house, and newspapers as yet haven't

carried any headlines about epidemics which have started in them. This is more than can be said of many of the other districts in the city. The trailer certainly meets a need, and there is no use shouting about something that fills a definite need because it will come in spite of you. The shout that trailer occupants pay no real estate taxes is an empty complaint. No one living can escape paying taxes and if these people, in the minds of the city authorities, are not taxed heavily enough then the system of levying taxes should be changed. Sooner or later, we are going to find that the tax system of cities is out of date anyway and it will be the planner's job to figure out a better one.

So, I believe that zoning, from the planning angle, is important and important to enforce. Once a zoning ordinance is on the books, it is generally the job of the superintendent of public works or the city engineer to enforce it. It is also his job to see that those who complain about the restrictions go away with the right picture in mind and without feeling that the ordinance is no good. No one comes to you to tell you that zoning is good or that your plans are good, but only to complain. If you can't satisfy them, they will try to bring pressure on the mayor and council. When that happens, you will have the mayor and council added to the number opposing you. Zoning and planning are helping to make cities worth-while places in which to live and cities must keep in step.

Zoning is technical enough to require an expert's advice in the preparation of an ordinance, and if it is prepared by an expert, don't condemn it when he isn't around. At least give the ordinance the benefit of the doubt until you are sure you know what it is all about and understand it yourself. Most people don't, because they are lazy or don't want to know. That group includes many public works officials too.

No one wants to live where there is continual smoke, or where traffic is going by his door all the time, or where trees and grass won't grow. Good business doesn't want to locate where there is no business, and industry doesn't want to locate where it is bound to have trouble. At least, they do not after they have tried it. Cities that do not provide the desirable environment for residences, good locations for business, and economical locations for industry, are going to be left out when the census taker comes along. The city planner cannot do it all. You men have got to help and, after all, 90 per cent of it should be in your laps anyway.

Administering Public Services During A Great Flood

J. Eugene Root

Director of Public Works, Cincinnati, O.

A catastrophe, or, in this instance, a great flood, may mean much or it may mean nothing, depending on various circumstances affected by or related to the result of flood waters in excess of the channel capacity of a stream or river. There are many urban areas which could be just as seriously affected by a flood height in the stream of less than twenty feet as by one having an eighty-foot height, as was experienced in Cincinnati in January of 1937. The words "a great flood" are, therefore, only relative. As a matter of fact, when the Ohio River at Cincinnati is reported as being in flood at a height of fifty feet, we go about our usual daily tasks and are, for practical purposes, as unconcerned as when the river has a pool stage of eleven feet. In the great flood of Pittsburgh in March 1936, the maximum river stage was about forty-two feet, but the inconvenience to its citizens and their losses were extensive. At Cincinnati, when the Ohio reaches fifty-five feet we begin to take notice, and our interest is intensified to the extent of the maximum height the flood will reach before receding.

For many years prior to 1937 practically all of us were satisfied that the maximum possible flood occurred in February 1884, when a height of slightly over seventy-one feet was recorded. The flood of last January bettered the previous maximum by nine feet. To illustrate the effect on an area basis, the seventy-one-foot flood of 1884 inundated approximately 6,400 acres of city area, whereas the eighty-foot flood of 1937 covered approximately 9,600 acres, or about one and one-half times the area for the extra nine feet in maximum flood height.

Cincinnati has an area of seventy-two square miles, with a population of approximately 480,000. Paralleling the Ohio, the city has about twenty miles of river front. Near the central section of the city a stream called Mill Creek, draining an area of one hundred and sixty square miles, discharges into the Ohio. At the peak of the flood, backwater from the Ohio extended up this creek for a

distance of seven miles. The topography may be generally classified as rugged, with an elevation above sea level of four hundred and thirty feet at the river and nine hundred and seventy-two feet at the highest point.

The catastrophe—if such it may be called—as applied to city services occurred on the evening of January 24, 1937 (a Sunday), when the city's water works and the electric generating plants of the Cincinnati Gas & Electric Company were submerged and their operations ceased. Partial service was restored by the water works in ten days and by hookups with electric plants at Dayton and Indianapolis in three or four days. Complete service for both was restored in about two weeks' time.

Immediate Steps Taken

On Monday morning the entire city was placed on what was called a "Sunday" basis. However, in reality this amounted to a disaster basis, inasmuch as no industries were permitted to operate, all stores except food and drug stores were closed, theatres and schools were closed, there was no rail transportation, and the use of automobiles was not permitted in the basin of the city. This complete overnight change caused no hysteria and during the period it was in effect the citizens generally met the situation good-naturedly and cooperated with the general committee selected to direct and coordinate activities during the emergency.

I believe you will be especially interested to learn the composition of the general committee of fourteen members appointed by the mayor: the city manager as chairman, the safety director, chairman of the local Red Cross, executive director of the Community Chest, the industries, represented by the president of Procter & Gamble Co., the fuel dealers by the president of their organization, the food dealers by the president of the B. H. Kroger Co., light and power by the president of the Cincinnati Gas & Electric Co., street transportation by the president of the Cincinnati Street Railway Co., rail transportation by a vice president of the New York Central Railroad, health by a doctor from the Academy of Medicine, business by a leading insurance and bond agency, city council by the chairman of the Finance Committee, and the president of the Board of County Commissioners. This committee was selected by the mayor late Sunday, began to function before noon on Monday, and met daily as a committee for more than a week. As I view

it, the successful way in which the city passed through and worked itself out of the emergency was largely due to the fact that the city manager and the heads of all the city departments were on the job Sunday and Sunday night, and prior to Monday morning had many plans under way and in suggested form to be placed in effect immediately upon receiving approval by City Council.

The Problem of Water Supply

As we viewed the preview picture, an actual catastrophe could have its inception in the cessation of our water works. Therefore, late Sunday afternoon, before water pumping actually ceased, we had men on the phone contacting owners of equipment suitable for hauling water in quantity—equipment such as that used for delivering gasoline from bulk plants to service stations. Thirty-two companies responded to this solicitation. Later the cities of Cleveland, Columbus, Dayton, Hamilton, Fort Wayne, Xenia and Piqua furnished street flushers and tank wagons for water distribution.

At the same time we were locating possible hauling equipment, other city employees were locating possible sources of water supply, such as driven wells, and making a selection of possible sites at which were to be placed large tanks to serve as local community distribution centers. The city established and maintained sixty-five local distributing places where water could be obtained for family drinking and cooking purposes. In addition, the hospitals, orphanages, homes for the aged, refugee stations, and similar institutions were furnished water by truck delivery. Prior to and during the time the tanks were being secured and placed, the city obtained about 15,000 empty but previously used whiskey barrels from a local distillery.

Inasmuch as there were four main stations at which water originated, and about two hundred delivery points, a special crew which worked on a two twelve-hour shift basis as a dispatching organization was selected in order to avoid confusion and duplication.

For the ten days this emergency water service was in effect we hauled an average of 350,000 gallons per day. Of course this was not all of the water used in the city during the emergency. The water works, for one hour in the morning and one hour during the evening, opened valves at storage reservoirs and at tanks, placing in the mains a temporary supply which was available in certain sections of the city. Also, there were many private con-

cerns and families who hauled their own water for domestic use.

Can you imagine a piece of automotive equipment on which a revolving drum is mounted, and which bears the words "ready-mix," hauling anything but concrete? Forty pieces of this type of equipment were placed in our "sanitary" service. Modern homes with toilet-bowls function best on a water basis. With no water their effectiveness ceases. However, insistence on their continued use, with a dry flush, resulted in conditions, we were told by many home dwellers, that were not so pleasing. Some of the more thoughtful of those comprising our "brain trust" organization, with a personal conviction that the homes must, by all means, be kept sanitary and odorless, made every arrangement for the lumber, the carpenters, and the final placing of an old-fashioned outhouse with a one-hole seat over the sewer manholes in the streets throughout the city. This was considered (by some) as the real solution to a bad sanitary situation, until it was pointed out that the sewers in the city streets had little or no water flowing in them, and also no water or the personnel to keep the sides of the manholes nor the one-hole seats clean and sterile. Also, in some sections of the city, a police force would have been needed to keep the prospective customers from crowding in their quest for a sanitary spot to light. As a finale to the happy thought, the city was divided into forty areas, the concrete buggies were secured, their tanks filled with water, and one was routed through each of the forty areas, making house-to-house delivery of water to be used for toilet flushing purposes only and unsafe for cooking or drinking even after boiling. Their presence on the street was announced by the ringing of a bell. For better than a week two deliveries were made daily.

Disposal of Refuse

Waste collection and disposal continued daily. Special service was rendered to twenty-six refugee stations which were established by the Red Cross. About half of the area used for disposal of ashes, tin cans, and other combustible material was under water, which necessitated rerouting and considerable extra mileage to dispose of the material collected. To operate the incinerators water was hauled for damper cooling and at one time for steam. As long as there was no electric current for power purposes, burning was done by natural draft through the smokestacks.

Rehabilitation of city buildings and removal of the debris left by receding flood waters was started immediately. For the first week there was no water in the mains for flushing, so hand-brooms and scrapers were used, along with mechanical bladers and bulldozers where conditions were favorable to their use. To handle the street cleaning work the city's organization was augmented by about 4,000 W.P.A. workers for a period of a month. One police station and eight firehouses, four buildings at the municipal airport, and two miscellaneous buildings were damaged by the flood waters. The repairs and rehabilitation of these properties were taken care of by our property maintenance division, assisted in some cases by the W.P.A. organization.

To administer as well as render public services during a catastrophe it may be briefly stated as absolutely essential

1. To establish immediately a central authority to direct as well as to keep in control community necessities on an emergency basis. The composition of this central authority to be one in which the people of the afflicted community will have full confidence.

2. Through and by approval of the central authority, the issuance of reasonable restrictions for the conduct of communal life and activities, these restrictions to be modified or changed from time to time as the cause or effect of the emergency changes.

3. By means of the radio, the press, telephone, etc., to court public acquiescence and cooperation during the emergency period as a necessary means for the effective working of the plan adopted and placed in operation by the central authority.

4. To think twice before you act; act quickly, sanely, with no hysteria; be thoughtful, cheerful and considerate in all public relationships; and without fail, at some time during the twenty-four-hour day, get some sleep and complete physical relaxation, even if only for half an hour.

DISCUSSION

CHAIRMAN ANDERSON: What did they do about fire protection in some of the higher sections of the city where no water was available?

MR. ROOT: Well, to start with we had a million-and-a-half dollar fire on Sunday morning at about ten o'clock. The fire area, occupied by storage tanks of the Standard Oil Company, was under

about five feet of water and close by was the Crosley Radio plant. The firemen worked in water up to their waist, or as far as they could wade. Monday we had a fire on the hill top, which is one of the highest places in Cincinnati, and to fight it we had to have seven pumpers lined from the Ohio River up to the top of the hill. The pumpers were placed so that one pumped into the other until the water finally reached the top.

MR. C. S. SHAUGHNESSY (Philadelphia, Pa.): Was there any increase in the death rate during that period?

MR. ROOT: So far as I know there were no deaths due to the flood. Of course, we had the normal deaths during the emergency period. We had a little typhoid scare prior to the middle of January, but the typhoid was less at the end of the flood than it was at the beginning, according to the health authorities' statistics.

MR. WM. B. SHAFER: In Pittsburgh we had to dispose of fish, fruit, and decayed meat. We had no way to dispose of that except by digging trenches and burying it. We dug trenches eight and ten feet deep and two feet wide and dumped everything into them. How did you take care of your decayed fruits?

MR. ROOT: The same thing was done in Cincinnati. The greater part of the area flooded was down at the commission houses and about half of the box cars in the railroad yard were loaded with fruit or other perishables. They were reloaded on about twenty freight cars and brought out to a dump and buried. We had orders from the man sent in by the United States Health Department for the inspection and condemnation of food to close down our incinerators to city purposes and to burn at our incinerators all this material he was going to condemn. However, a few of us thought that the best thing was to take care of our citizens first and the condemned materials could stay there a month without harming anyone. Eventually they were reloaded and hauled away in railroad cars and then disposed of in the manner I mentioned.

CHAIRMAN ANDERSON: Did you clear up the debris on the streets with city equipment?

MR. ROOT: All the equipment used was city equipment. We have a little flood every year to contend with and our highway maintenance forces, as soon as the water starts to recede, begin to shove the debris right into the water. This time a great deal more of it had to be loaded on equipment, because for more than a

week we had no water in the city mains and the only flushing we could do was what we did with our regular street flushing equipment. We did not rent any special equipment.

The funny thing about the whole flood, even though the water was very high, was that the only street that was seriously affected was the one you saw in the slide, and that cost us twenty thousand dollars to fix. The bridge had wood blocks for a floor and they all floated away. We also had another street with wood block pavement and it floated away. Outside of that there was no physical damage to the city streets. One or two sewers cracked, or two caved in, but the whole damage to our Department of Public Works did not exceed fifty or sixty thousand dollars.

MR. G. J. REQUARDT (Baltimore, Md.): How high is the floor of your suspension bridge?

MR. ROOT: I would say about seventy feet above pool stage, and the floor was just touching the water, or what we call the bow of the bridge.

CHAIRMAN ANDERSON: Are there any more questions?

MR. ROOT: I would like to make one comment in connection with floods. As I have said in the paper I just read to you, a fifty-foot flood does not mean anything, and a fifty-five-foot flood only a little more, but the history of Cincinnati is that in a period of eighty years we have had five floods which have exceeded sixty-five feet. One of those floods was sixty-five and one-tenth feet, and so we really had only four floods sixty-six feet and over, two of them being in excess of seventy feet. So, we don't worry much about them. However, a good deal of thinking is being done about them, and no doubt there will be some good flood control methods developed in the Cincinnati area.

MR. D. W. GODAT (New Orleans, La.): Was there any damage to the foundations of any of the buildings of the city?

MR. ROOT: A great many of the buildings you saw in the slides were damaged buildings that were condemned by the city health department. Most of those buildings were seventy-five to one hundred years old and of brick construction. However, a great many frame buildings and brick buildings were entirely destroyed and a good many of them will never be replaced.

MR. GODAT: Were any of the modern buildings damaged to any great extent?

MR. ROOT: None of the modern buildings were damaged. They

just cleaned them up afterwards and went back to work in a few weeks.

MR. J. HENRY QUIRK (Bradford, Pa.): How do they figure the river rise?

MR. ROOT: Our river or pool stage is eleven feet from the bottom of the river or sea level elevation and the figure I quoted to you is measured from the bottom of the river.

MR. SHAFER: What mark did you reach in 1936?

MR. ROOT: I think we had sixty-two feet in 1936. The thing that caused this big flood was a general rainfall in the Ohio River area which saturated the ground one hundred per cent. Whatever rain fell after a period of time was just one hundred per cent run off. In addition to that, two days prior to the flood we had a snow storm of eight inches. It was bitter cold then and we thought that the river would surely stop rising. Well, by six o'clock Sunday night there was not a bit of that snow to be found. The temperature changed and the rainfall in that area was just about the same as that we experienced yesterday in driving into Atlanta.

We have a little river just east of the city that drains four or five hundred square miles and that river was full. The Kentucky side has a similar river and those two just came right in. However, the big volume of water that caused the height really originated in the upper part of the river around Pittsburgh and they all reached Cincinnati about the same time.

MR. QUIRK: What protection have you set up against another flood of that type?

MR. ROOT: We are planning to have a filtration plant on the top of a hill high enough so that it will not be flooded unless it goes to something over ninety feet.

MR. QUIRK: What provision did you make for safe domestic water following the emptying of your line?

MR. ROOT: We told the people to boil the water regardless of where it came from, and most of the water came from Norwood. The City of Norwood furnished us with water that they pumped out of the wells for draining purposes right in the factory, and we obtained it from the factory. But, when we delivered it to the people everybody was told, and the point was insisted upon, that they should boil the water before using it for drinking purposes. That is one reason our typhoid rate was lower at the end of the flood than it was at the beginning of it.

MR. FREDERICK T. PAUL (Minneapolis, Minn.): What method of sterilization did you use when you resumed pumping?

MR. ROOT: For three weeks we used the chlorination process.

MR. H. L. WILSON (Johnstown, Pa.): Do you know the estimated velocity of the flow at the peak of the flood?

MR. ROOT: I am not sure but I think it was about ten miles per hour.

MR. T. R. KENDALL (New York, N. Y.): Did you have any breaks in the water mains?

MR. ROOT: Only one or two. As soon as the water plant went out the water works people sent their maintenance crews out and turned off all the valves that were in the areas affected by the flood, so that the system was out of commission all of the time during the flood and for quite a little period after the water works went back into operation. It was drained as far as they could drain it and at that high chlorination we had to take some kind of a chance.

MR. JOHN STUCKE (Rochester, N. Y.): Did you have any trouble with sanitation?

MR. ROOT: Those out-houses I mentioned were not placed on the city streets, but that was about the only way we could handle such a bad situation.

MR. GODAT: In connection with the restoration of the electric service, did the utilities have very much difficulty in getting spare parts to replace the equipment that had to be baked out?

MR. ROOT: No, they were all baked out and in operation within three weeks after they went out completely. I suppose you know that the Cincinnati Gas & Electric Company is a subsidiary of a company that generates current in Louisville, Dayton, Indianapolis, and Springfield, and so we had to use candles at our house for only two nights. We were permitted to burn one light when we had this emergency light service and to use the radio, because most of the announcements were made through a broadcasting station.

MR. GODAT: I was thinking about the difficulty of obtaining something to fit your equipment.

MR. ROOT: No, we did not have any trouble about that. They were all baked out and replaced in ten days.

Needed Research in Concrete Pavements

H. F. Clemmer and Paul W. Downey

Engineer of Materials and Asst. Engr. of Materials, District of Columbia

The design and construction of concrete pavements has made steady advance during the last decade but many of the basic facts pertaining to the building of pavements were developed as early as 1920, when the Bates Road Experiments and those conducted in California, as well as the many research projects of the Bureau of Public Roads, were carried on. It was from the conclusions formed from such studies as these that many fundamental facts of the design and construction of concrete pavements were learned. It was these experiments that established the need of a center longitudinal joint when constructing pavement slabs of greater width than twelve feet; that the thickened edge design offered uniform slab strength; that pavement surfaces could be constructed to a high degree of smoothness; that the moisture content of subgrades should be controlled to reduce volume changes, and many other facts.

Many of the problems of pavement design are definitely interrelated and balanced design must be considered as a unit; that is, we must consider such factors as slab length, pavement thickness, warping stresses and subgrade support as one problem, due to the many interrelations existing. However, since it would be confusing to discuss the problem in this manner, each phase is considered separately, so far as possible.

Subgrade

It is of particular interest to note that in all of the studies referred to, little definite information was developed as to the supporting value of subgrades. Improvements in subgrade soils were brought about by careful preparation, but no definite information was available which would permit actual bearing values for subgrade support to be taken into account.

In the design and construction of all engineering projects, the study and the determination of the bearing power of the subgrade or foundation is the first duty of the engineer. However, due to the lack of sufficient knowledge of how to obtain definite support and bearing value of soils, the highway engineer has disregarded

consideration of subgrade support and designed the rigid type slab as a cantilever. Actual experience over a number of years has generally proved the adequacy of pavements designed in accordance with this general formula, as developed by Mr. Older, former Chief Engineer of the Illinois Highway Department; but there are additional factors, such as the internal stresses caused by temperature and moisture variations, which should be given consideration in this design formula.

The lack of recognition of these internal stresses, and the increased weight of traffic over that for which the pavements were designed, have undoubtedly been compensated for in many cases by the excessive strength designed into the slabs due to the fact that no allowance was made for the supporting value of the subgrade.

Probably the most wanting field for immediate research in connection with the design and construction of concrete pavements is that in which the properties of subgrades are considered in their relation to the pavement slab—from the design, as well as the economic standpoint. It has always been recognized that different subgrades exhibit entirely different properties, but, until the Bureau of Public Roads and other research groups demonstrated the possibility of altering subgrade characteristics, subgrade problems had been listed mainly among the intangibles. However, as a result of the consideration given to the importance of our secondary road system during the past five years, a wealth of knowledge has been accumulated on subgrade problems; for, during this period, a major portion of our highway construction and planning has followed the stage construction plan, which appears to be a most economical and logical procedure to follow.

The stage construction plan is based fundamentally on securing a high service subgrade which may be utilized in all future developments of the project; that is, in the initial development stage, as a smooth all-weather surface, and, finally, as a thoroughly compacted base, offering maximum and uniform supporting value for a higher type pavement. Research is necessary, however, to determine the extent to which known subgrade characteristics pertain to pavement construction, for in balanced design the foundation as well as the superstructure must be considered.

Preliminary researches conducted during the Bates Road Study definitely indicated that the moisture content of the soil affected

its behavior as a subgrade. Studies by Dr. Strahan of the University of Georgia on a number of sand-clay and top soil roads, resulted in the formulation of a tentative classification of soil roads, in which grading of soil mixtures was also established as a criterion for judging performance of such roads in service.

With these studies as a background, supplemental researches have been conducted most extensively by the Bureau of Public Roads, many state highway departments, as well as by numerous commercial organizations. These studies have resulted in the formulation of basic principles for the design of soil mixtures in which the granular and cohesive properties of soil are balanced to effect maximum stability. An application of these principles led to the "Stabilized Road," a type of construction in which the fine and coarse aggregates, soil binder, and moisture maintained in an optimum amount, are combined in such a manner that the resulting mixture is one offering maximum all-weather stability. In this connection, a Specifications Committee on Stabilized Roads for Municipalities has been appointed by the President of this Association during the past year and a report which includes "Specifications for Materials for Stabilized Base-Course" and "Specifications for Roads Stabilized with Calcium Chloride and Binder Soil" is being submitted at this meeting.

Soil engineers have already devised tests to determine the bearing value of soils, and when sufficient research and study have been completed so that these test results have practical application, the engineer will be able to substitute a "supporting" value in the design formula used to determine the required thickness of slabs under particular conditions.

Slab Length

In considering the development in highway design, it is interesting to follow the cycle of changes in slab length. In constructing the first concrete pavement (The Bellfontaine Project) the slabs were laid in approximately ten-foot lengths. The value of the short slab was not realized, however, and a construction period followed during which slabs were poured continuously, the length depending only on the amount of concrete which could be placed daily. As a result, "blow-ups" were prevalent. As early as 1915, the American Concrete Institute issued a report indicating the need for a definite slab length. In 1924, the State of California limited the maximum

slab length to about sixty feet. It was not until 1934, however, that the Bureau of Public Roads issued a memorandum requiring that "expansion joints be placed at intervals of not greater than one hundred feet, and that provision be made for crack control between expansion joints by the use of steel reinforcement, or suitably designed contraction joints or planes of weakness, so that the distance between joints will not exceed thirty feet." This recommendation has been adapted by the highway department of the District of Columbia to municipal construction. Reports recently presented by the Bureau of Public Roads, which will be referred to in greater detail, indicate that it may be desirable to limit further the maximum slab length. In other words, it can be definitely stated that the trend in highway design is toward shorter slab lengths, somewhere in the vicinity of that utilized in the construction of the first pavement project—The Bellfontaine Road.

Experience has proved that concrete slabs of great length will not remain intact; and that transverse cracks which ultimately occur present conditions which usually cause rapid failure of the pavement. If the concrete slab is designed and constructed so as to control these cracks, a more serviceable and durable structure is assured. The stresses set up during the hardening of the concrete may very likely exceed the unit strength of the concrete, unless slab length is controlled, and cause incipient cracks which later lead to ultimate failure of the pavement slab.

One of the first factors to be considered in determining slab length is the stress developed by the movement due to volume changes caused by variations of temperature and moisture. This stress is dependent upon the unit weight and length of slab, and the friction between the concrete and subgrade or base. A limited number of laboratory tests have been conducted to determine the friction stress that may be developed between the concrete and subgrade or base. As a result of these studies, it has been recommended that a coefficient of friction of approximately 2 be used. Field experiments have indicated that under some conditions this friction is a factor of the cohesive quality of the subgrade material, rather than the direct friction of the slab on the subgrade, as was assimilated in the tests. That is, the internal friction of the subgrade material, rather than the friction between the slab and the subgrade, may be the governing factor.

Also, experiments conducted by the Highway Department of the

District of Columbia have shown that the movement of a pavement slab was as unrestrained as that of ten-foot experimental slabs placed on sand bearings and metal plates so as to be free of friction stresses. It must be realized that slab movement is very gradual and undoubtedly there is a tendency for the individual soil particles to roll over one another, rather than create a direct friction stress with the slab. It is believed these examples illustrate that field tests under all general conditions are necessary to determine definite facts on subgrade friction.

Warping Stresses

A further factor of particular concern in considering pavement slab length is warping of the concrete slab. Warping stresses are the result of temperature and moisture variations between the top and bottom surfaces of the concrete slab and may greatly exceed those induced by a maximum wheel load application. Warping stresses have not, however, been given consideration in the design of our concrete pavements, due to the fact that we have lacked a basis upon which to design for such stresses.

Studies reported by the Bureau of Public Roads,[1] however, have given us a foundation on which to formulate future research. Basic factors, which are pointed out by these investigators, show that the reduction of such stresses can most practically be brought about by reduced slab length. For example, it is shown that "the longitudinal warping stress in a ten-foot slab is consistently much smaller than the corresponding stresses in a twenty-foot slab . . . . the average reduction in the critical warping stress caused by the decrease in slab length, is approximately 66 per cent in the interior of the slab and 89 per cent in the point near the free edge." Considering these preliminary data and noting the magnitude of the warping stress even in a slab of twenty feet in length, the warping stresses in slabs of greater length must be enormous. (Table 1)

As is apparent, pavement thickness is also a factor creating temperature differentials and, likewise, warping stress. Preliminary studies by these same investigators (Table 2) indicate that an increase of temperature differential of approximately 33 per cent may be expected when comparing pavements of nine-inch and six-inch thicknesses. It may further be noted that longitudinal warping stress in a pavement of thickened edge design (9:6:9) exceeds those

[1] Teller and Sutherland, Bureau of Public Roads.

stresses developed in either a nine-inch or a six-inch uniform section by approximately thirty per cent. As pointed out by the authors, however, "the relations between slab length, slab depth, and restrained temperature warping were not determined. To study this problem, a range of slab lengths in each of several thicknesses would have to be constructed and the critical warping stresses determined for each. Such data would make it possible to determine what lengths of slab are sufficiently free to warp, to make relatively unimportant the increase in warping stresses that result from the increased edge thickness." The above studies, as pointed out by the investigators, cover only one set of conditions. Practical field checks under actual traffic conditions are accordingly necessary to determine the importance and the definite effect of warping stresses that may be developed in a concrete slab by varying slab lengths and thicknesses.

When it is realized that temperature and moisture changes are occurring daily and are causing repeated stresses, and that such stresses, together with those resulting from wheel load applications

TABLE I. OBSERVED LONGITUDINAL WARPING STRESSES AT THE EDGE OF THREE 20-FOOT PAVEMENT SLABS

	Temperature differential at edge			Observed longitudinal warping stresses			Increase in stress, 9:6:9 slab over	
Date 1934	6-inch slab (°F.)	9-inch slab (°F.)	9:6:9 slab (°F.)	6-inch slab (p.s.i.)	9-inch slab (p.s.i.)	9:6:9 slab (p.s.i.)	6-inch slab (%)	9-inch slab (%)
Apr. 18	18	27	27	220	—	316	44	—
Apr. 22	14	24	21	186	—	218	17	—
Apr. 24	21	31	29	195	—	291	49	—
May 9	18	25	24	209	191	245	17	28
May 18	21	30	30	—	298	380	—	28
May 19	20	26	29	252	306	380	51	24
May 20	23	33	32	—	302	361	—	20
May 21	20	31	32	320	329	409	28	24
May 22	—	—	—	322	252	347	8	38
May 24	19	25	25	266	213	282	6	32
June 2	—	—	—	229	251	336	47	34
June 3	—	—	—	281	273	377	34	38
				Average			30	30

TABLE 2. OBSERVED LONGITUDINAL WARPING STRESSES IN 10 AND 20-FOOT SLAB LENGTHS

Date 1934	Maximum Air temperature (°F.)	Maximum Longitudinal Warping Stress: Interior 20-foot length (p.s.i.)	Interior 10-foot length (p.s.i.)	Edge 20-foot length (p.s.i.)	Edge 10-foot length (p.s.i.)	Reduction in stress in decreased slab length: Interior (%)	Edge (%)
Apr. 26	68	307	132	—	—	57	—
May 1	74	376	142	—	—	62	—
May 2	71	—	—	121	68	—	44[a]
May 13	85	287	81	—	—	72	—
May 14	90	—	—	278	21	—	92
May 28	83	429	151	—	—	65	—
June 1	90	—	—	354	46	—	87
June 11	94	—	—	285	38	—	87
June 14	88	—	—	313	20	—	94
June 15	94	—	—	252	19	—	92
June 21	101	451	132	—	—	71	—
June 22	96	414	130	—	—	69	—
June 25	97	—	—	283	51	—	82
				AVERAGE		66	89

[a] Not included in the average.

may be sufficient to cause fatigue of the concrete, the importance of designing in order to reduce these stresses to produce a more durable and longer lived pavement may be appreciated. Surveys and studies of our high type pavements indicate that many such pavements remain entirely satisfactory for three to five years, but begin to show definite disintegration after that time. A consideration of the factors discussed may, accordingly, result not only in more satisfactory service with less cost, but a much longer service.

Moisture, as well as temperature differentials, may likewise create warping stress and it is undoubtedly in this respect that subgrades of uniform moisture content are to be desired over subgrades of varying moisture content.

THICKNESS

Without a doubt the quality of our concrete mixes has improved in the past ten to fifteen years. In many instances, however, highway departments are using the same minimum values for strength

as formerly determined as a basis for calculating the necessary thickness of pavement slabs from the formula $T = \sqrt{3W/S}$, where T is the edge thickness in inches; W the maximum wheel load in pounds; and S the allowable working tensile strength for concrete,

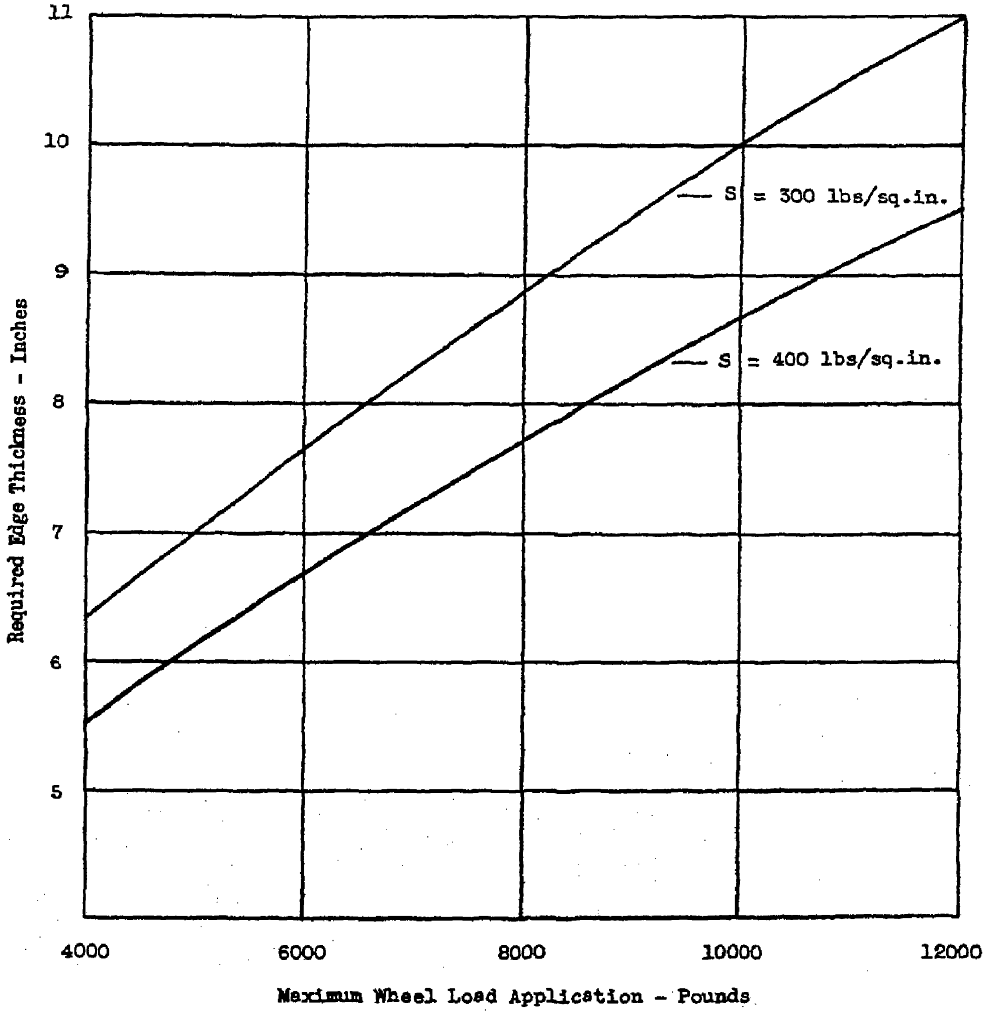

FIGURE 1. REQUIRED EDGE THICKNESS FOR VARIOUS WHEEL LOADS

which, when concrete is designed on a wheel load fatigue basis should not exceed fifty per cent of the modulus of rupture.

Figure 1 shows graphically the edge thicknesses required in designing pavements, using a working stress of 300 lbs./sq.in. and a factor of safety of 2. It is believed, however, that paving concrete designed using a cement content of 1.5 to 1.6 bbls. per cubic yard, will yield in excess of 800 pounds per square inch in 28 days under normal conditions. Such strength would permit a value of S of 400 lbs./sq.in. to be used and still maintain a safety factor of 2.

The safety factor of 2 is based on the fact that studies show the fatigue limit of concrete to be approximately 50 per cent of its ultimate strength. It seems unnecessarily precautious, however, to design *all* pavements for fatigue. For example, residential pavements, where truck traffic is limited, would never fail through fatigue due to wheel load applications. It is questionable whether it is necessary to consider a factor of safety for fatigue for such conditions; at least not for stresses due to wheel loads.

Research is necessary to determine the adequacy of a lower factor of safety for residential streets where wheel load fatigue is not a factor. The District of Columbia has for many years been using a 10:8:10 cross-section for all pavements. Recently, however, the thickness of residential streets, which because of their location will always carry light-weight traffic, has been reduced to 6-inch uniform section with integral curbing, which provides the benefits resulting from the thickened edge design.

Concrete Quality

Factors of design are of little importance if the quality of the construction material, the concrete, is not fully controlled. As stated, there has been a marked improvement during the past few years in the general quality of concrete, both in the control of aggregates and in the manufacture of cement.

Specification revisions and the issuance of new cement specifications show very definitely that the concrete engineer is no longer satisfied with the former "all purpose" cement. To cope with this demand for different cements, the Federal Specification Board has adopted four cement specifications covering portland, high early strength, sulphate resistant and moderate heat cements. It is also evident that the engineer is becoming more exacting in his requirements of a cement; for example, the chemical composition is more definitely specified, and too, obsolete test procedures (fineness and soundness) are being revised and eliminated and more pertinent tests substituted therefor.

Fineness is now specified in terms of specific surface and is determined in such a manner that the particle size distribution from the coarsest particle to the finest "flour" can be recorded. The engineer is also insisting on the inclusion of a test in specifications which will in some manner determine volume change characteristics. Accordingly, the auto-clave test has been presented to several

technical committees for their consideration and it is believed cement specifications of the future will undoubtedly include a volume change limitation.

A paper recently presented before the American Association of State Highway Officials discussed studies of concrete in which a portion of the standard cement was replaced by an equal quantity of a natural cement, and concluded that the resulting concrete showed greater resistance to weathering, as determined by the freezing and thawing test, than similarly proportioned plain concrete. Although the early strength of the blended mix was somewhat lower than that of the plain mix, equal ultimate strengths were developed.

Strength, and particularly early strength, has generally been regarded as the prime criterion of concrete quality. It is important, however, that the engineer determine as directly as possible the durability or resistance to weathering of concrete. A correlation of results from laboratory freezing and thawing tests on concrete with actual field results will provide the engineer with much needed information. For example, the paper referred to showed that the use of a concrete containing a blend of natural and standard portland cement resulted in improved durability of the concrete in both laboratory and field studies. To be considered as a general definite conclusion, this information is, of course, too meager, but it is believed the example serves to illustrate the need for research on the subject of durability. The results of the freezing and thawing test should show the resistance of the concrete to failing through stresses set up by volume changes due to temperature and moisture variations, as well as the direct effect of freezing and thawing.

Vibration of concrete to improve the quality and particularly the durability of the product, has been studied and has proved to be of value. Considerable experimenting is necessary, however, to learn the most efficient vibration methods. It has been indicated that the effect of vibration will not extend far into mass concrete, but it is believed the practice is particularly applicable to paving concrete since subgrades transmit vibrations more effectively than concrete. Conclusions presented as a result of extensive experiments and study by the Bureau of Public Roads[2] are most interesting: "(1) For a given water-cement ratio a saving of approximately 10 per cent in the amount of cement can be effected by the use of vibration with-

[2] F. H. Jackson.

out sacrificing strength and uniformity. (2) For a given cement content an increase in flexural and compressive strength of approximately 10 per cent can be obtained by the use of vibration."

It may be noted that concrete of equal strength was obtained with 10 per cent less cement and that 10 per cent greater strength with the same amount of cement resulted from the use of vibration. This improvement in strength is undoubtedly due to increased density which very probably improved the durability of the concrete as well. It is most important to determine the quality of the concrete with regard to durability, as well as strength, in considering the necessary amount of cement.

Many equipment manufacturers have become interested in this problem of vibration in the placement of paving concrete; but it is important that the engineer lead the way as to what is necessary for the best results. Such factors as the frequency and amplitude of vibration, the manner of application, etc., are important. The results of preliminary research indicate this practice will soon become universal.

Rather recently the Highway Department of the District of Columbia was particularly concerned with the placement of concrete around metal expansion joints, and after experimenting, specified the use of an internal vibrator. We have followed for about three years this practice of vibrating the concrete around all forms and joints with most satisfactory results; the check-up on possible honey-combing is no longer thought of. The cost of this practice is small and contractors are pleased to follow it rather than be concerned with proper spading and tamping.

Reinforcing Steel

Some years ago an extensive investigation was made by C. A. Hogentogler of the Bureau of Public Roads, and reported in the proceedings of the Highway Research Board, as to the value of reinforcing in concrete pavements. One of the most significant conclusions reached by this investigator was that the best results were obtained by well distributing the amount of steel used.

It has been general practice to determine the cross sectional area of steel on the basis of the amount required to hold the concrete slab intact when volume changes may occur. Theoretically then, the amount of reinforcement is directly proportional to the length and weight of the slab and the coefficient of friction between the

concrete slab and the subgrade. Many engineers believe, however, one of the most important factors in the use of reinforcing in pavements is that of distributing shrinkage stresses developed during the early curing period, which is the critical period in the hardening of concrete. The District of Columbia Engineering Department encountered considerable trouble with the formation of radial cracks around manholes and similar pavement openings. Such cracks not only presented an unsightly appearance, but were an actual structural weakness. After observation and experiment, it was found that the use of small mesh (chicken wire) placed about two inches below the concrete surface eliminated these cracks.

Without doubt, closely spaced mesh reinforcement tends to distribute the shrinkage stresses which occur during setting of the concrete, and incipient cracks, which may later develop into definite failures, are minimized. Tests made by the Bureau of Public Roads, and again reported through the Highway Research Board, show that the installation of reinforcing reduces the shrinkage of concrete, during the first one hundred minutes following placing, more than 50 per cent.

It is believed a lesser amount of steel would be required for the purpose of distributing shrinkage stresses during hardening of the concrete than has generally been specified to hold the slab intact. With this in mind and in consideration of shorter slab lengths, the District of Columbia Highway Department has reduced the weight of steel mesh from fifty pounds to thirty pounds per hundred square feet.

Considering the foregoing examples, and the trend in the design of rigid type pavements, it is evident research and experiment are needed to develop the importance and value of reinforcing in concrete pavements.

Joints

The memorandum issued by the Bureau of Public Roads, requiring the use of expansion joints in Federal Aid Highways, and also the use of contraction joints or reinforcing between expansion joints to control cracking, provided the impetus for development of expansion joint assemblies by manufacturers of highway products. As a result, many types of joints are being offered on the market, including the metal air-cushion, cork, bituminous, rubber, com-

pressed fibers, and combinations of these materials. These joints do not differ materially in functioning as expansion joints, but may differ in functioning as contraction joints, due to such properties as resiliency, adhesion, and recovery after compression; and too, whether or not the surface of the joint may be sealed, either by copper, as in the case of the metal air-cushion type, or by bituminous or rubber mastics. Durability and adaptability seem to be the most essential features of joint materials and it is expected research and practical field installations will undoubtedly lead to improvements in these materials.

With respect to joints, a major problem confronting the engineer is how to provide efficient load transfer at such planes; and it is on this problem that research is particularly needed. It is important to learn the efficiency of the various load transfer units being offered at the present time and the effect of proper subgrade support on such efficiency. Laboratory tests have been conducted on individual types, but it is important to determine the effect of dowel spacing, the effect of width of joint, the effect of bearing area of load transfer, to learn more directly the load distribution efficiency of various systems. Such laboratory studies should be correlated with field results.

Summary

The foregoing discussion has attempted to show many of the problems on which research data are most desired. A knowledge of the stresses in a concrete pavement is, of course, most vital to the engineer in his attempt to provide a structure of balanced design, that is, one in which the ratio between initial cost and serviceability is a minimum. Research data which will permit the design of pavements for minimum internal stresses, and which will also determine the extent to which subgrades of uniform and high supporting value may be utilized must be available, however, before "balanced" design can be effected.

This discussion applies to concrete pavements in general, but its application to municipal construction is our prime interest. Municipal construction seems to differ from state construction in that zoning in cities is a universal practice; property lines, as a whole, are more fixed; and the existence of residences makes it impractical to alter the right of way except in most urgent cases. Too, it is believed the nature of the traffic in cities, especially on other than

through routes, will be more constant than that on state systems. For example, a state system may well have served its purpose at the end of ten to fifteen years, and rebuilding may be necessary due to the change and increase in traffic which could not be anticipated; while a municipal system of highways with its more constant nature of traffic should, if properly designed and constructed, be serviceable to its limit of durability. As a result, we should without doubt consider our design problems to a greater degree of refinement, and in even greater detail than state organizations.

Needed Research in Bituminous Pavements

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Many of the problems connected with the bituminous types of road construction have been with us for many years. Progressive changes in the methods of manufacturing and handling of bituminous materials, and the development of new designs and methods of use, are continually bringing up new problems for us to deal with. Although some of these are concerned primarily with the bituminous material, other factors such as the aggregates, the design and fabrication of mixtures, and construction procedure, often have an important effect on the behavior of the pavements and call for research and study.

There is no doubt that the bituminous material has often been blamed for the failure of the road when the fault was elsewhere. Improper design of the surfacing, use of an unsuitable grade of bituminous material or type of aggregate, unsatisfactory control in preparing the mix or in laying the surfacing, are common faults among which the causes of road failure are often to be found.

Although it cannot be emphasized too strongly that there are factors other than the quality of the bitumen that may be to blame

for numerous failures, many problems definitely connected with the character and the behavior of the bituminous material itself remain to be solved.

For example, we still need a satisfactory laboratory method for quickly predetermining the weathering qualities of a bituminous material. The need for such a test has long been felt but no satisfactory method has as yet been developed for making such determination. However, much progress has been made, indirectly at least, in solving this problem. Sampling of bituminous surfaces that have been in service for various periods, and the recovery and testing of the bituminous materials from the existing pavements by methods now available, are providing us with more definite information on the comparative weathering properties of bituminous materials. It is important, however, that much more field and laboratory work of this sort be done in order that we may know with a greater degree of certainty the range in weathering qualities that may be expected, and how important this matter of weathering really is.

Weather Resistance

Laboratory studies by several investigators indicate that there are great differences in the weather resistant properties of various bituminous binders. Fluid products undergo losses of volatile matter as well as oxidation and carbonization, often to the extent of making them ineffective as binders. A careful selection of the proper bituminous material to fit the particular type of construction would materially reduce maintenance on many of the low cost bituminous roads. While the bituminous binders used in the higher type of construction are also susceptible to deterioration during service, the process is in general much slower and the cause of failure in these higher types cannot as often be directly attributed to the weathering qualities of the binder.

Recent studies have shown that while most asphalt cements will readily meet the specification requirements for per cent of loss on heating for five hours at 325 degrees F., many of them are changed materially during the mixing process even though the temperature of the mineral aggregate and asphaltic binder is not exceedingly high. In many cases, the bituminous materials extracted from hot mixes have shown that the ductility and penetration of the asphalt cement have been greatly reduced. The brittleness and tendency to

crack that is evident in many asphaltic pavements may therefore be due not so much to actual weathering as to the hardening of the asphaltic binder at the mixing plant. Undoubtedly there is an urgent need for the development of a laboratory test which will indicate more readily those asphalts which may be expected to harden unduly in the mixing operation, as well as a test which will distinguish the relative durability of various grades and types of asphalts when used in different types of paving under particular climatic conditions.

Damage in Mixing Process

Of great importance are the studies being made to determine how seriously asphalt is damaged in hot plant mixing operations and what means may be employed to overcome such damage. Recent work by a number of investigators indicates that a surprising amount of hardening occurs in certain asphalts when mixed with aggregates in the average mixing plant using present common practice as to time and temperature. It is the opinion of the men who have studied this problem that further work along this line and the modification of plant design and mixing temperatures in line with the results will greatly improve the behavior of the hot mix type pavements.

Work already done has demonstrated that the penetration of some asphalt cements may be reduced as much as 50 per cent during the ordinary mixing operation at temperatures not exceeding those used under present specifications. It has also shown that the amount of hardening varies for different asphalts of the same original consistency and for any one asphalt processed in different types and sizes of mixing plants.

The following tabulation gives the test results on two typical sheet asphalt projects showing the change in the penetration and ductility of the asphalt that occurred in the ordinary mixing process:

	Penetration 77 F. 100 gram, 5 seconds			Ductility 77 F. 5 cm per min.		
Project 1	min.	average	max.	min.	average	max.
Asphalt from storage tank......	53	56	58	153	206+	250+
Asphalt recovered from mixture.	36	37	39	28	48	82
Project 2						
Asphalt from storage tank......	56	57	58	244	247+	250+
Asphalt recovered from mixture.	40	43	45	127	168	191

It seems obvious that when an appreciable hardening of the bituminous material occurs in the mixing operation such hardening necessarily affects the life of the pavement. Heating in bulk, in tank cars, or in other large containers, has less effect than the hardening that has been found to occur in many instances when a thin film of asphalt coats the hot aggregate in the presence of air. The normal hardening of the asphalt in the pavement has also been found to be a comparatively slow process with the average asphaltic material, and may therefore be much less important than the damage possible in the mixing plant.

If hardening of the asphalt in the mixing operation is as extensive as it seems to be, it is a matter of considerable importance in connection with the design of the pavement, since satisfactory behavior often requires that the asphalt be of a certain consistency in order that the surface will have the flexible qualities required for a particular base condition.

We often hear of bituminous surfaces cracking particularly on the somewhat flexible types of bases, and of the tendency to get away from this fault by obtaining a more plastic mix by using a less viscous grade of asphalt, often in conjunction with a more open type of aggregate. It is entirely probable that some of the trouble has been with the mixing operation and might have been eliminated by adjusting the mixing time and temperature to better suit the particular bituminous material used.

Experience with the dense type of bituminous concrete on the more rigid types of bases seems to indicate failure when the penetration of the asphalt in the surface mix approaches 20. For the less rigid types of base, cracking and failure might of course be expected at a somewhat higher penetration. That certain asphalts are less susceptible to temperature changes and less affected by the high temperature in the mixing operation seems to be indicated by such studies as have been made and by field behavior. I recall a number of instances where a large amount of cracking on hot, plant-mixed, sand-asphalt surfaces occurred with certain asphalts, while on similar surfaces using other asphalts, cracking did not occur. Although the cause of the difference in behavior was not definitely known, it is possible that it may have been due primarily to the comparative resistance of the asphalts to hardening in the mixing process.

I believe it is a fact that the mixing temperatures now commonly

used are those thought necessary years ago when asphalts from only a few sources were available. These temperatures may be unnecessarily and injuriously high when used indiscriminately with the many materials now used. Certainly studies should be carried on to determine the minimum practical mixing temperature of the materials to be used and the time of mixing required. Comparative consistency studies of various types and grades of bituminous materials in conjunction with mixing studies would provide valuable information in connection with this problem.

A recent investigation in Germany by E. Gerlack of mixing processes based on laboratory work indicated (1) that high mixing temperature did not offer sufficient advantage to warrant its recommendation, (2) that low mixing temperatures call for a longer mixing period, (3) that the chief differences in the coating process are governed by the binder content of the mixes (4) that lean mixes require an increase in mixing time and (5) that raising the speed of the mixer does not accelerate the mixing process but impairs the quality of the output.

Control of Stripping

Stripping of bituminous material from aggregate under the action of moisture is now receiving considerable attention as a possible cause of failure with certain types of aggregate and with some types and grades of bituminous materials. It seems highly desirable that aggregates and bituminous materials be tested for their resistance to stripping as a prerequisite for use in construction.

Field experience indicates that stripping may have been a factor in some instances of failure because of the character of the aggregate and in other cases because of the type of bituminous material used. Surface mixes composed of asphalt cut backs or other types of cold-laid materials which contain a fraction of solvent or certain types of slow-curing oils are highly susceptible to stripping previous to evaporation of the solvent. In general it is not a safe proposition to use a cut-back material late in the fall of the year when the evaporation of the solvent is greatly delayed and moisture conditions are likely to be unfavorable.

Aside from the special behavior of the slow-curing oils and the cut-back asphalts, there does not seem to be much distinction between the more viscous materials in their resistance to stripping. The aggregates, however, have widely different adhesive properties

and some of them, even when coated with asphalt, are highly susceptible to the action of water.

Although considerable work has been done in connection with stripping of asphaltic film from mixes and the factors involved, it still remains an important problem for research. A number of tests have been developed, several of which seem to be satisfactory to the extent of showing visually a difference in the behavior of certain materials. They are, however, all unsatisfactory to a degree in that they do not provide any means of accurately determining the amount of stripping.

Efforts to provide a satisfactory test are being made by several agencies. A committee of the Highway Research Board is cooperating with a number of agencies in attempting to develop a satisfactory test and to determine the factors which influence that type of failure in the pavement.

Adhesive Qualities

Notable work on the adhesiveness of bituminous binders on aggregates has been carried on in Germany during the last few years by Riedel and Weber. They have not only developed a method of test but have arrived at some very interesting conclusions regarding the effect of certain factors, some of which are given below:

1. The wetability of minerals by bituminous binders can be greatly influenced by soap, alkaline, acid, or neutral electrolytes. The relation between this influence of the electrolyte and the adhesiveness was found, and a method developed for determination of the adhesiveness.

2. It was demonstrated that asphalts, tars, and oils of different origin did not differ much in respect to wetting power, but that, on the other hand, there existed great differences between the minerals, so that while different binders adhered equally well to the same aggregate, disregarding trivial deviations, a given bitumen had widely varying adhesion values with different aggregates. Aggregates of the same type of rock from different sources showed great variations in wetability by the binder so that, accordingly, generalizations concerning stones of the same class can lead to erroneous conclusions.

3. The adhesiveness of a binder precipitated from an emulsion on the aggregate can under certain circumstances, according to the

kind of emulsifying agent, be poorer than that of the hot application bitumen, since emulsifiers and stabilizers influence adhesion unfavorably.

4. Fluxed tar is not well distinguished from tar without flux. Cold application tar can be used without question on wet aggregate only as long as the aggregate has hydrophobic properties. On wet hydrophobic aggregates cold tar adheres poorly.

5. To hydrophobic minerals all binders adhere well; to hydrophilia poorly. Between these two extremes lie the conglomerate rocks, which are composed of mixtures of hydrophobic and hydrophilic particles.

As noted previously, the methods of test proposed are in general not entirely satisfactory in that they do not provide the means whereby the amount of stripping can be accurately determined. The work of E. Gerlack in determining the efficiency of various methods and effect of various factors in the mixing process may offer a possible lead to a means for determining more accurately the amount of stripping.

The method he used for determining the amount of uncoated surface area depended upon the absorption of dye from aqueous solution by the uncoated stone surfaces and the colorimetric estimation of the amount of dye absorbed. The principle involved would seem to offer possibilities in connection with the stripping tests now in use and those laboratories which possess a colorimeter might well do some work along this line.

Stabilization

Another phase of road building on which both laboratory and field work needs to be done is in connection with the use of various types and grades of bituminous materials in stabilizing subgrades and base courses for surface construction. Such preliminary work as has been done seems to indicate great possibilities for bituminous materials in this field as well as the need for further study as to materials and methods to use. In view of the promising results obtained so far, I believe it can safely be assumed that much investigational work will be carried on during the next few years and that such studies will be well justified.

Bituminous stabilization of soil appears to be accomplished by securing a water-resistant coating on the active fine particles, those finer than the No. 200 sieve. The actual result of stabilization is

therefore not to increase the natural stability of the essentially dry soil but to preserve a large portion of its natural stability which might easily be destroyed by water without the protective bituminous coating.

Since the particles above the No. 200 size are believed to be largely inert to the action of moisture, it does not appear necessary to secure a coating of the larger particles. It is possible that we would obtain equally satisfactory results if we segregated the fines, were this practical, and confined the treatment to this fraction alone.

Since the active fines largely determine the behavior of the material, the practice of basing the amount of bitumen on the quantity of this fraction seems reasonable. Present practice is to use around 15 per cent of the bituminous stabilizer based on the material passing the No. 200 sieve, the total aggregate having up to a maximum of about 4.5 per cent bitumen. It is believed that soils requiring an excess of this amount can often be stabilized more economically by other means. Although the above statement covers in general the practice as to the quantity of bitumen, further laboratory and field work should be done on this phase of the work.

The addition of moisture to facilitate the mixing and consolidation processes is common practice and its importance is definitely established by laboratory and field work. The volume of water required for the mixing operation seems to be somewhat in excess of the predetermined mineral voids in the thoroughly compacted aggregate, while for consolidation the amount should be somewhat less. The addition of water in the mixing operation makes it possible to use a considerably more viscous bituminous material than would be possible without water. However, information is needed as to what is a desirable consistency as well as concerning what types of materials are best suited.

The high resistance to displacement by moisture offered by certain cracked liquid asphaltic materials would suggest possibilities for this type of material. Other factors which seem to merit investigation in this connection are the determination of the chemical and physical characteristics of the soil that affect the actions of the bituminous materials and the development of methods modifying these physical and chemical characteristics.

I have attempted to enumerate and describe briefly a few of the problems which are of importance in the design and construction

of bituminous highways and pavements. The problems mentioned as well as other difficulties which may be more or less general, will undoubtedly be solved by close coordination between those workers in the laboratory and the construction and maintenance departments.

Needed Research in Brick Pavements

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AFTER a recent unfortunate building experience, the president of one of our oldest small colleges said that carpenter builders have had lots of practice but no experience. His meaning is obvious and municipal engineers engaged in paving practice might be charged with the same weakness at times. There has been a tendency on the part of too many of us to repeat our mistakes and to lack proper curiosity concerning the reasons for our paving successes and failures. Some attempt in recent years to find some of the answers and incorporate them in standard specifications for this Association has made the writer a meek man indeed. He has heard some of the leading authorities on paving brick and brick pavements say "I don't know" on many occasions—and the bigger the man and the wider his experience the more liable he was to have more questions than answers. An occasional brave soul seems to feel that he is sure of a few things and very, very infrequently one finds a poor innocent engineer who seems certain that he has all the answers. It must be very satisfying to arrive at that stage in life.

At a recent meeting of the Board of Directors of this Association, when the employment of a man for some research work was being discussed, a member expressed himself in favor of the project, provided a man could be obtained who had lived long enough and made enough mistakes in this line of work. The writer has made enough mistakes in pavement construction to qualify and is old enough to admit them safely. This paper might very properly be titled "What I don't know about brick paving," and is in part a personal confession.

Subgrades and Curbs

The subgrade problem is standard with all pavements and probably gets the least intelligent treatment of any portion of the job. We carefully crown a tight clay subgrade to get uniform pavement thickness and to provide subgrade drainage but give little thought to what happens at the low points along the curbs where the water may collect. In hundreds of cases curbs or curbs and gutters have been laid on expensive broken stone bases and backed up with the same for drainage purposes. These drains, after collecting water from subgrades, have been dead-ended at street intersections to concentrate the damage where it is certainly not wanted. Cross drains have been placed at intervals to drain subgrades which are nearly impervious when we really know that water could not travel six inches through the clay in question. Soil stabilization is yet only a title to most engineers although this new practice probably offers the greatest possibilities for increased pavement load capacity and long life. We are told that a few cents a yard spent for subgrade stabilization will repay large dividends. This is undoubtedly true if the stabilization is properly done but at present we seem to be in the hands of the manufacturers of different materials who all see a new market in this field. All materials and methods are not good and we need some neutral research agency to handle the situation without gloves so that we may all profit from reliable information on this subject.

Base courses under brick surfaces have been controversial for years. Brick surfaces have been laid on everything from the native sands and crushed lime rock of Florida to the crushed slag of the steel mill districts, with native gravel, concrete of a variety of mixes, and a small quantity of so-called black base in general use over the country. Good economics—and the engineer must at all times consider economics in pavement design—frequently dictates the use of local materials for bases. If the native sand soil in frost-free Florida will support a brick surface at least cost over a period of years, it would be foolish to use concrete. On the other hand, politics may dictate a slag base in a steel town where a heavy concrete base is needed. Concrete is generally accepted as the best base for brick but that still leaves the question of what the mix shall be and what thickness and type of reinforcement, if any, shall be used.

The rich versus the lean mix is an old fight, with cities pretty generally favoring lean mixes and state highway departments rich ones. The high coefficient of contraction and expansion of the rich base with resulting large cracks and loss of bed under the brick is serious. Lean mixes confine these cracks to very narrow ones, almost none at all if some reinforcement is used. Additional depths are possible. Elaborate contraction joints are necessary in the rich mixes. On the other hand such rich mixes are undoubtedly stronger. Some cities use as little as five inches of lean concrete (1:3:6 mix) and others as much as eight to ten inches of rich concrete. Such a wide difference in practice cannot be accounted for by varying load conditions. Nearly every small city today has some streets which get as great a concentration of traffic as the larger cities. Forty-year-old brick pavements on gravel bases in the writer's own city put to shame many younger ones on concrete and do not add to his confidence on this subject.

An arbitrary city line does not make eight inches of 1:2:4 concrete base desirable on one side of the line and five inches of 1:3:6 concrete satisfactory on the other side when both carry the same traffic. There certainly ought to be some information made available which would convince the most skeptical and standardize base course design, at least under standard conditions. One answer is surely better than the other. Which is it?

We must, of course, recognize the fact that many engineers believe nothing but their own experience and do not follow the results of research. Research results must be made available and read to be useful. Someone recently preached a sermon on the "Unreality of Unused Things." An unread and unused report of technical research becomes unreal indeed and becomes a living thing only when studied, and the results thereof made the basis for improved actual construction. There is available today much carefully done but little read work on bases. We still need to realize that base design and construction on roads to carry the same traffic might vary considerably due to different subgrade conditions. Load distribution capacity of the wearing surface, if any, should also be considered and it is probable that different types of surface call for bases of different strength. More work on proper design would involve long-time studies on different mixes and thicknesses of concrete with the same surface resting on varying subgrades under varying weather and climatic conditions. In the

case of a brick pavement, the cushion or bed material and type of filler used might affect the results. Shall we use the stronger concrete mixes or, when taken in combination with these other parts of a brick pavement, will the leaner mix give the better result?

In general, the important load-carrying part of a pavement, the prepared subgrade and the foundation, are too often designed by absolute guess or from habit. The best brick surface often fails due to base failure, and as a result the surface material gets a black eye. Who knows the load-carrying capacity under the impact of modern speeds of that base we laid recently? Doesn't the typical city use the same base on "Quiet" street and on "Main" street? Don't we say that such and such a town uses a certain thickness of concrete of a certain mix for all conditions? Certainly we need some more scientific approach to base design for most of us. We had a fine paper on this subject a year ago. There is yet a great deal to be done.

Cushion or Bed Course

The cushion problem is rivaled only by the question of fillers for first place in any brick paving discussion. Brick have been laid on plain sand, crushed shells, stone screenings, slag sand, granulated slag, sand cement, bituminous mastics and directly on the green concrete base. Almost anything which could be raked or struck with a template has been used for a brick bed. In the old days thick cushions were the rule and with the roughly finished bases of those days, a large variation in thickness was permitted. These heavy cushions of unstable material shifted and resulted in a rough pavement. Slag, sand, granulated slag, and in some cases limestone screenings were more stable but in time became thin slabs of concrete-like material having no bond to the base or the brick, and left the brick resting on a material with no bedding or cushioning qualities. While some pavements with such beds are in good shape, great numbers have failed. All the above cushions or beds are still used to some degree but the crying need for a stable bed material with some flexibility has resulted in the development of the so-called bituminous mastic consisting of a good sand, machine mixed with asphalt or tar. The words sand, asphalt, and tar are such broad terms that they can mean a variety of things. The best specifications today, defining the characteristics of the

materials in this mastic bed and their proportioning and mixing, allow so much latitude that they are not an adequate guide to the engineer. Experiences vary so much that a committee writing so-called standard specifications is forced to leave them very open. The best practice is not yet definite enough to justify a tight specification and more information is needed.

The need is for a bed which can be readily and cheaply mixed and applied and which will be sufficiently stable to permanently retain its position and shape. This permanent stability is essential if the brick surface is to remain smooth—smoothness combined with traction are the things of major importance in the minds of the motorist today. An all-weather road or street is of little interest to him if it does not ride well. The bituminous mastic bed, as a general idea, seems to be on top and gives the most promise of meeting the requirements. We still differ, however, on too many details. The screen analysis of the ideal sand, the kind and quantity of tar or asphalt, the desirability or undesirability of asphalt emulsions or powdered asphalt, and many other questions have plagued the research man and the conscientious engineer. Tar seems to work easier than asphalt but, if too little is used, seems to have a faculty of disappearing entirely, and too much makes a mixture which gives construction trouble. Some asphalts are more stable but are hard to work, and emulsions and powdered asphalt have not been howling successes. We admit that mixes must be varied with different sands and tars or asphalts of different physical characteristics but successful mixes are pretty largely the result of cut-and-dry methods or may even be accidental. There is yet plenty to be learned about bed courses.

Types of Brick

The brick themselves have always done a pretty fair job of performing their function and when some of the old pavements are studied we really have reason to marvel. Small brick laid on little or no foundation have given streets which are serviceable after a long period of years. The sixty-odd sizes and types of paving brick which have been manufactured at different times bear witness to the fact that tastes in brick have differed widely. The Permanent Committee on Simplification of Varieties and Standards for Vitrified Paving Brick has reduced the number of standard sizes to four. The choice of standard types is entirely

in the hands of the user, as the exclusion or inclusion of any size or type depends entirely on the percentage of the total shipments during any construction season. That this method of selection is not entirely sound is proved by the fact that one of the four types which are still standard has been one of the first to fail in test roads and on accelerated wear tests. This type also provides the poorest traction of any brick made.

The manufacturer and the research agencies are unanimous in their choice of the superior types of brick but the problem is to get the individual engineer to inform himself as to the results of such research. Individual search of the literature should be made. Brick today should be square edged, have small non-meshing lugs on both ends and one side which leaves only enough joint space to admit the filler and should expose a wire cut or roughened surface to the traffic. These conditions are met by the vertical fiber lug types, uniform as to length and width and made in different depths. There seems to be little excuse for the use of other types unless a similar type can be developed having rough sides and ends to assist in bonding the filler.

The greatest field for research seems to be in the quality and the importance of tests of the brick themselves. The Proposed Tentative Specifications of the A.S.T.M. Designation C7 restricts the number of large pieces remaining in the rattler after a test. Other agencies are studying the possibility of beam and crushing tests.

The introduction of de-aired brick has given us what seems to be a superior product but different manufacturers are having trouble standardizing it. This brick is more dense, will absorb less water, and shows generally a much lower percentage loss in the rattler, but the results of tests are at times rather erratic. Sufficient information is not yet available as to the significance of certain wide-range results to enable the specification writer to take maximum advantage of this development in specifying brick. This brick at its worst is undoubtedly the equal of those manufactured by former methods and at its best has the characteristics of good granite block. It is possible and probable that the next few years will see the development of a very uniform de-aired brick and that present-day research will develop testing technique which will enable the engineer to specify a brick which will be far better than his fondest hopes a few years ago.

Brick has always been considered a high type of pavement and the fact that the surface itself has been a factory manufactured article has made possible a uniformity of product which is much more difficult to obtain under field manufacturing conditions with some other types. The laboratory will give us a still better product.

Laying and Rolling

Some change has taken place in the laying of the brick. It is no longer good practice to spread joints in laying around a curve, as everybody admits the desirability of the minimum joint which will admit the filler. Wide joints start trouble. As the result of study, your Specifications Committee is recommending elimination of the so-called running the joints on curves and the use of more wedges where necessary. In the battle for smooth riding, test roads are again being built with the brick laid parallel to the axis of the road. This reduces by one-half the number of joints driven over. These roads will be watched to find what price, if any, is paid for this advantage.

Rolling practice is under fire. Nobody seems very certain as to the proper weight of the roller. Ideas run all the way from three to ten tons. With smoothness requirements running to one-eighth inch in ten feet, rolling becomes very important. The writer does not know of any work being done which will clear up this confusion and satisfy any large number of us that we have the answer. Perhaps the weight is not as important as we have thought in the past.

The use under the roller of one-inch boards laid parallel to the axis of the street on top of the brick has been developed at Richmond, Va., and has resulted in smoother work and less broken brick. This practice has been adopted elsewhere and promises to come into general use. It is said to add little, if anything, to the cost of the work. This idea will bear watching.

Fillers and Excess Filler Removal

Nearly everything under the sun has been used at some time as a joint filler for block pavements. Sand, cement grout, tar, asphalt, tar and asphalt mastics, blended mixtures, sulphur, and many other combinations have been used and are still being used either in test roads or general practice. In one hilly Pennsylvania city, the city engineer still favors sand because he says the brick are more

easily cleaned and relaid when he is forced to gather them up at the foot of the hill after frequent violent storms and relay them. Cement grout has been a complete failure in some cities while occasionally one of the finest and most serviceable streets proves to have a grout filler. While pretty generally condemned by city pavement designers, several new sections of state highway are being built with grout filler. Ohio is again experimenting with monolithic construction, a type in which the brick are set in the green concrete and cement grout filled. Expansion joints are being used with these types. It will be interesting to watch these results and see whether methods are being developed which will overcome the old faults inherent with this type of construction and retain its good qualities.

The so-called soft fillers are almost alone in the field today and are being given a great deal of study. Straight asphalt is the leader on the basis of use. This type of filler should have a rather high viscosity and ductility, a high melting point and a low penetration. The material should be of a type that will not exude from the joints and spread on the surface of the pavement but will cling tenaciously to the sides of the brick and be sufficiently ductile to stand movement of the surface under temperature changes without separation. Some compromise must be made here as this combination is difficult or impossible to obtain. The use of blended materials, mineral filled in some cases to form a mastic, is being tried in many places and in several test roads. Efforts to add mineral material in the field have met with poor success due to segregation of the mineral matter, but one or two plant mixes are on the market which seem to have everything. One of these materials has been used apparently successfully in the brick approaches to one of the New York tunnels. A test road has been built near Columbus, Ohio, using everything known or even suspected of being a good filler and as a result of careful observation of this piece of road, twelve regular contract jobs are being built this year using the four fillers which seemed to meet the requirements. These requirements are that the filler be non-exuding, leave a non-skid brick surface, and remain in the joints to do the work for which it was intended. These four materials are a rather hard blended asphalt, a mineral-filled blended asphalt, a special coal tar pitch and a sulphur-asphalt mixture containing from 38 to 42 per cent of sulphur.

It is essential that a modern brick pavement present a filler-free, non-skid surface at all times, and the job of the research man is to find a filler that will leave this kind of a surface while performing all the other functions of a good brick filler. Fine pavements are being built with the asphalt fillers of today but there is room for improvement and it is gratifying to know that the Research Bureau of the National Paving Brick Association and the state universities and highway departments of several states are working on this problem. The Mellon Institute and numerous commercial laboratories are also cooperating.

The application of a separating agent to the surface of the brick to make possible the removal from the surface of surplus filler is almost standard practice today. Ordinary lime whitewash or calcium chloride solution are the common agents used and either one will break the bond between the brick and the filler so the latter may be removed from the surface. The trouble is that the introduction of such materials into the joints will also break the bond there and thereby harm the pavement. The safest method of application of this separating agent known at present is to paint it on with a three-inch brush, but a fine spray is more commonly used and careless use of this method may be fatal. The Paving Brick Association and other agencies are struggling with this application problem which offers an opportunity for any mechanically inclined person to make a contribution to our paving practice. It is also possible that a better separating agent may be found or a filler which is sufficiently non-skid to eliminate the need for surface removal. This entire problem of excess removal is more acute on high speed state roads than on city streets, although removal is desirable on both.

A complete brick pavement consisting of a stabilized subgrade, a good concrete base, a stable cushion, and a good de-aired vertical fiber lug brick with well filled joints exposing a filler-free wire-cut surface to the traffic is as high a type and as serviceable a pavement as we can lay, but it is high in first cost in most parts of the country. If we are to justify this higher cost we must be alert to find the answers to most of the problems outlined earlier in this paper so that we may guarantee a smooth, non-skid surface with low maintenance cost and the long life we have learned to expect from this type of pavement in the past.

Sewage Disposal in Atlanta

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It is the purpose of this paper to outline in a general way the program of sewage treatment recently undertaken by the city of Atlanta, and some of the reasons for the methods adopted.

Atlanta is blessed by nature in being situated on a series of high ridges, approximately 1,000 feet above sea level. This blessing, however, somewhat complicates the sewage disposal problem.

The natural drainage of the city is divided into three distinct watersheds. The north and west portion drains into small creeks which discharge into the Chattahoochee River about eight miles east of the city, which eventually flows into the Gulf of Mexico. A small portion of the southern part of the Greater Atlanta District drains into the head waters of the Flint River, which joins the Chattahoochee at a point near the Florida line some two hundred miles south. The east and southeast part of Atlanta drains into tributaries of the South River which eventually flows into the Atlantic Ocean by way of the Ocmulgee River.

The Chattahoochee watershed, which receives the major portion of the city's sewage, is divided into three natural drainage districts—Peachtree Creek, Proctor Creek, and Utoy Creek. The South River watershed is also divided into three basins; Sugar Creek, Intrenchment Creek, and the head waters of South River itself. In the early days of Atlanta, raw sewage was discharged into these small streams.

Nearly all the main sewers in Atlanta are combined storm and sanitary sewers.

The Problem

As early as 1908, the pollution of the small streams around Atlanta was recognized as a real problem and the newspapers of the city conducted an extensive campaign urging abatement of the nuisance.

In 1912, Herring and Fuller, engineers of New York, designed three sewage disposal plants; one constructed on Peachtree Creek, of 8 M.G.D. capacity; one on Proctor Creek, of 3 M.G.D. capacity and one on Intrenchment Creek of 5 M.G.D. capacity. These plants, begun

in 1910, were modern in their day, being the first Imhoff tank plants built in the United States. The last one was finished in 1914. They consisted of hand-raked bar screens, hand-cleaned grit chambers, Imhoff tanks, and sprinkling filters. The sprinkling filters, owing to shortage of funds, were limited to 2½ acres at the Peachtree Creek plant, 1½ acres at the Proctor Creek plant, and 2 acres at Intrenchment Creek plant. All were 6½ feet deep.

The city grew rapidly and these plants were soon badly overloaded. The growth of the city has been largely in a northerly direction, extending beyond Peachtree Creek, so that the old Peachtree Creek plant is now located in the center of a high-class residential area, although partially isolated by city-owned property and a public golf course. The city has also extended westward beyond the Proctor Creek plant location. The growth in the southerly direction has not been so pronounced and the Intrenchment Creek plant, though overloaded, is still well isolated and so located that it can serve the present built-up areas in this section of the city.

In recent years, not only was a large proportion of the sewage going to the plants bypassed to the creek without treatment, but many additional sewers were built which discharged direct into the creeks, either without any treatment whatever or after passing through very inadequate septic tanks. As a result, Peachtree Creek, throughout its entire length from Decatur to the Chattahoochee River (a distance of approximately thirteen miles), became virtually an open sewer traversing an important residential area, and a source of great nuisance. This condition obtained not only in the creek itself but in the small tributary branches, particularly to the north, into which was discharged sewage from private real estate developments. The same condition existed in other creeks in the west, south, and east of Atlanta, a condition which caused the then Mayor, James L. Key, to remark that "Atlanta is an island practically surrounded by sewage."

Early Studies

Before discussing the program of sewage disposal recently undertaken by the city, it might be of interest to review briefly some former studies and recommendations. In 1929, the firm of Whitman, Requardt and Smith, engineers of Baltimore, were employed by the city to make a preliminary survey of the conditions in Atlanta and to recommend remedial measures. This survey and report covered

the Greater Atlanta area and recommended the construction of new intercepting sewers to serve this area, which would permit combining the Peachtree Creek and Proctor Creek watersheds in one sewage disposal plant located on the east bank of the Chattahoochee River, combining South River, Intrenchment Creek, and Sugar Creek watersheds into one plant located at the junction of these streams, together with smaller plants serving small watersheds from which the sewage could not be readily diverted to these main locations.

For the Peachtree-Proctor Creek valleys, a 55 M.G.D. separate sludge digestion, trickling filter plant was recommended, at a cost of $3,000,000. For the South River valley, a 28 M.G.D. separate sludge digestion, trickling filter plant was recommended, at a cost of $1,500,000. The total cost of all sewage disposal plants recommended, including three other small plants, was $4,800,000. The total estimated cost of all interceptors recommended amounted to about $6,000,000, making the total cost of the entire project $10,800,000, based on construction costs prevalent at the time. The estimated operating cost of all the plants was $136,000 per year.

This proposed program was very comprehensive and complete but, coming as it did just at the start of the depression, it appeared to be too large an undertaking for the city.

In the years following the presentation of this report, much interest was revived in the United States in chemical precipitation as a means of sewage disposal and a number of plants of this type were built. In 1932 the city granted to certain interests the right to conduct experiments at the Peachtree Creek plant, with a view to making tests of the "Lewis Process" of chemical precipitation. Associated with Colonel Lewis were the engineering firms of Parson, Clapp, Brinkerhoff and Douglas, and Alexander Potter, engineers of New York City. Under the direction of these engineers, an experimental plant of one-half M.G.D. capacity was operated for about six months. This work was carried on without cost or obligation to the city of Atlanta.

At the conclusion of these tests, the engineers made a report to the mayor of the city, recommending the adoption of chemical precipitation as a means of sewage disposal at the two larger plants, one of which was to be located near the Chattahoochee River, to treat the sewage from the combined Proctor-Peachtree Creek valleys, this plant being of 43 M.G.D. capacity, and consisting of

primary treatment with provisions for chemical precipitation during low flows in the stream.

The second chemical precipitation plant was to be located at the junction of South River and Intrenchment Creek, and consisted of chemical precipitation followed by rapid sand filtration. The plant recommended at the latter site was to be of 20 M.G.D. capacity.

The estimated cost of the disposal plants recommended, including three small plants for isolated areas, was approximately $1,500,000. The annual cost of operation was estimated at $178,000, which anticipated the use of chemicals at all times at the South River plant and the use of chemicals during dry weather flows only in the Chattahoochee River plant.

At this time the question of sewage disposal for the city was referred by the mayor to the Engineering Council of the Chamber of Commerce and a committee of local engineers was appointed by the Council to consider the various phases of the problem.

This committee reported that, in its opinion, the conditions on the Chattahoochee River were such that chemical treatment might well be considered for use during the infrequent low flows of the stream, inasmuch as plain sedimentation would suffice for the major portion of the time, and recommended that studies be made on the river to determine the degree of treatment required. On the smaller streams, where complete treatment would be required at all times, the committee felt that the well-known biological processes appeared more trustworthy and economical.

Experimental Plant Installed

In view of certain existing opposed opinions as to the effectiveness of the trickling filter in treating Atlanta sewage, and lack of authentic data on the operation of the old Intrenchment Creek plant and, further, in view of the many new developments in the sewage disposal field, the city installed an experimental plant in 1935 at the Intrenchment Creek plant site for the purpose (1) of determining the efficiency of the old trickling filters operating under normal conditions on Atlanta sewage; (2) of determining the economy of the Laughlin Magnetite filter in the removal of suspended solids; (3) of learning the effectiveness of chemical precipitation as applied to the Intrenchment Creek sewage; and (4) of determining what could be accomplished by a modified chemical treatment used in conjunction with the old trickling filters.

Experimental work was conducted over a period of about eight months. Studies were also made of the Chattahoochee River and other streams, to determine the degree of treatment required to prevent nuisance.

During the course of these studies, the availability of federal funds through P.W.A. and W.P.A. made it possible for the city to proceed with the construction of the sewage disposal program. At this time, in the light of new developments and the additional data at hand, the city adopted a sewage disposal program which became the basis for applications for grants from the federal agencies.

It will not be possible to describe in detail in this paper the studies made or the plants finally constructed, but the following is a general outline of the program adopted. It is followed by a brief discussion of some of the considerations in reaching these conclusions.

The Program Adopted

It was decided that the old Peachtree and Proctor Creek plants should be abandoned and one plant constructed on the banks of the Chattahoochee River to serve these valleys. This plant is now known as the Clayton Plant. This plant is designed for clarification of the sewage by sedimentation and digestion of the settled sludge in separate digesters. It is equipped for sterilization of the settled sewage with chlorine, when and if needed. It is thought that such treatment will be adequate on the river except during extreme dry weather conditions when the flow in the stream is very low. For use during such times provisions have been made for a more complete removal of organic suspended solids and colloidal matter by chemical precipitation.

This type of plant is relatively low in first cost and the chemical treatment should be economical because the use of chemicals will be restricted to short periods of time.

Since the streams on the south side of the city are small, a high degree of purification is necessary to prevent nuisances. It was decided that the Intrenchment Creek plant should be retained in service, but modernized and enlarged. Tests conducted at this plant indicated a combination of a modified chemical treatment in conjunction with the existing trickling filters to be both effective and economical.

A separate plant was proposed on South River to treat the sewage emptying into that stream and which could not be conveyed to the

Intrenchment Creek plant by gravity; this plant to be of the separate sludge digestion, trickling filter type.

Other small plants were proposed on Utoy Creek, Beaver Creek and Flint River, to serve small isolated areas.

Summing up, it was decided that chemical precipitation would be economical and applicable where partial or seasonal treatment only is required; that sedimentation, followed by trickling filters, would be most practical on the smaller plants, where a continuous higher degree of purification is required; and that a combination of a modified chemical treatment, in connection with trickling filters, at the old Intrenchment Creek plant, would permit of salvaging a great deal of the investment in this plant and would result in increased efficiency at the plant and real economy.

As a result of studies made on the Chattahoochee River and its tributaries, it was apparent that the immediate problem on the Chattahoochee River watershed was largely one of removing the pollution from the small tributary streams flowing from the city and its environments to the river, as these were the immediate source of nuisance. Rarely, under ordinary dry weather conditions, did the discharge of sewage into the river itself cause depletion of oxygen to such extent as to cause the river to become septic or offensive. The worst conditions in the river, as noted by observations, occurred at times during which the river was extremely low and local showers occurred in the city which were not of sufficient extent to increase the flow of the river appreciably, but served to flush out the accumulated sludge deposits in the small tributary streams, resulting in a wave of excessive pollution passing down the river on such occasions.

It should be borne in mind that the Chattahoochee River is a free flowing stream with good opportunity for re-aeration in its course. The stream is, at all times, high in turbidity and red with the color of Georgia clay.

The studies made indicated that during average low flows, say from 750 to 1,000 sec. ft., the dissolved oxygen in the stream was at no point lower than approximately 70 per cent of saturation and the maximum 5-day B.O.D. of the river water occurred at a point about nine miles down stream and was approximately 4 p.p.m.

These tests further indicated that at a point about thirty miles down stream the 5-day B.O.D. of the river water was not more than 1 p.p.m., and the dissolved oxygen content of the stream at this point was approximately 80 per cent of saturation, showing the

remarkable power of the stream to assimilate the sewage by natural processes. It might be noted that the total bacterial count of the stream at the time tests were made reached a maximum at approximately 280,000 per c.c. at a point about fifteen miles down stream and this count was reduced to normal about thirty miles down stream.

At the present time, no municipality takes its water supply from the Chattahoochee River above Columbus, Georgia, which is approximately a hundred miles below Atlanta. In the design of the plant on the Chattahoochee River it has been estimated that on the basis of the present contributing population (230,000), sedimentation alone will suffice when the flow of the river exceeds 720 sec. ft., or approximately 3.1 sec. ft. dilution per 1,000 population, and that when the stream flow is less than this, additional treatment will be required.

Under 1950 conditions, with an estimated contributing population of 300,000, the estimated critical flow will be 930 sec. ft., and under 1970 conditions, with an estimated population of 400,000, it is estimated that the critical flow will be 1,240 sec. ft.

A study of the stream flow records over a period of many years indicates that a flow of 720 sec. ft. will be maintained better than 95 per cent of the time; that a flow of 930 sec. ft. will be maintained better than 90 per cent of the time, and that a flow of 1,240 sec. ft. will be maintained at least 75 per cent of the time. It might be stated that the flow in the river very rarely falls below 600 sec. ft. in ordinary years, although under extreme drought conditions, as in 1925, the minimum flow for a short duration was 225 sec. ft.

Under the above conditions, it was decided to construct on the Chattahoochee River a plant providing sedimentation in conjunction with pre- or post-chlorination, facilities being provided for chemical precipitation when and if desired. The plant is designed for 42 M.G.D. dry-weather flow and consists of mechanically cleaned bar screens and grit chambers, followed by a chemical mixing basin using diffused air, which can be used as a pre-aeration basin when chemicals are not used. Four 112-foot-diameter settling basins are equipped for mechanical removal of sludge. Sludge is to be digested and dewatered on vacuum filters. Elutriation of sludge was provided in the plans but eliminated at least temporarily when contracts were awarded. The digesters are of the two-stage type; the primary tanks are provided with mechanical stirrers; and the

secondary tanks with gas holders. Sludge gas will be utilized in internal combustion engines for generating power for use in the plant. Chemicals are to be handled pneumatically from cars to storage and to chemical feed machines. The use of chemicals in this plant will be infrequent for some years to come but will probably increase in time as the population load on the watershed increases. The cost of the plant as constructed is about $830,000.

The construction of this plant at this site will permit the abandonment of both the present Proctor Creek plant and the Peachtree Creek plant.

The construction of an intercepting sewer in the Peachtree Creek valley, approximately thirteen miles long, is in progress, together with a number of branch sewers to intercept all sewage now being discharged into Peachtree Creek and its tributaries by the cities of Atlanta and Decatur and unincorporated areas in Fulton and DeKalb counties. A new interceptor will also be constructed from the new plant site to the Proctor Creek plant, which will remove all sewage now being discharged into this stream.

A separate smaller plant has been constructed in the Utoy Creek valley which also discharges into the Chattahoochee River. This plant is of 3 M.G.D. capacity and provides for sedimentation, with separate sludge digestion. The point where Utoy Creek enters the River being approximately seven miles south of the Clayton plant site, it was more economical to construct a separate plant at this site than attempt to convey this sewage to the Clayton plant.

After studies of the results obtained by the operation of the experimental plant at Intrenchment Creek, it was decided to remodel this plant and utilize the existing structures in so far as possible and maintain it in operation, constructing a separate smaller plant on South River to treat the sewage in this area.

While other studies indicated the Intrenchment Creek plant should be abandoned and a new plant located at the junction of Intrenchment Creek and South River, it was finally decided that by use of the process adopted it would be more economical to retain the old plant and construct the smaller plant on South River, as above stated. Also, the Intrenchment Creek plant is well isolated, and even if a combined plant were built at the junction of the two streams it did not seem that the Intrenchment Creek plant should be abandoned at any early date but, in the interest of economy, should be used to capacity; in which case there would still be two

plants operating on this watershed. The scheme proposed of utilizing the old plant and constructing a second plant on South River saved some $470,000 in first cost, which represents the cost of sewers involved to convey the sewage to the junction of the streams and the salvage value remaining in the old plant structures which could readily be utilized in the new project.

Modifications to the old Intrenchment Creek plant are now nearing completion. The present average dry weather flow is 9 M.G.D. The basis of design of the new structures is 14 M.G.D.

In the remodeled plant, provision has been made for the introduction of chemical treatment for conditioning of the sewage ahead of the primary clarifiers and trickling filters, when desired, diffused air being utilized in the chemical mixing basin. The structures used for mixing can also be used for pre-aeration without chemicals.

Due to the presence at times of caustic wastes from textile industries causing excessively high pH, provisions have been made for controlling the pH by the introduction of CO_2 in the sewage, CO_2 being recovered either from the sludge gas or the stack gases after burning the sludge gas in the gas engines or hot water heater.

The primary clarifiers consist of seven tanks equipped with drag type sludge collectors, the old Imhoff tanks being converted to this purpose.

An additional acre of trickling filters has been added to the filter bed, making the total in the new plant three acres.

After leaving the trickling filters, the sewage flows through a final mixing basin utilizing diffused air, which can also be used as a final aeration basin whether chemicals are being used or not. After leaving this final mixing or aeration basin, the sewage flows through a final clarifier equipped with a Laughlin Magnetite filter, and from this unit to the creek.

Sludge is digested in two-stage digesters, equipped with a floating cover on the primary and a gas holder on the secondary. Sludge gas is used for generating power for use in the operation of the plant.

The digested sludge is to be dried on open sand drying beds.

The South River plant recently completed is a 6 M.G.D. capacity, separate sludge digestion, trickling filter type of plant.

The Clayton plant, South River plant, and the Utoy Creek plant were constructed as P.W.A. projects, by contractors, the city paying 55 per cent of the cost. The Intrenchment Creek plant and all sewer extensions are being constructed as W.P.A. projects.

Sewer Extensions

There is included in the project about seventy-eight miles of sewers, ranging in size from 8 inches to 90 inches in diameter.

The main interceptors leading to the disposal plants from the combined storm and sanitary sewers are designed to carry three times the dry weather flow as estimated for conditions in the year 1975. The future flow estimates are based on a flow of 125 gallons per capita with added allowances for business and industrial districts.

The estimated future population used as a basis of design of the main sewers is 700,000, or about twice the present population of the Greater Atlanta area.

Concrete sewer pipe has been used throughout the work except for 18,000 feet of 90-inch sewer connecting to the Clayton plant, which is constructed of concrete, formed and poured in place in the trenches.

Below is a tabulation of the cost of the project as undertaken. Where the work is done by contract, the contract cost is given. In case of the W.P.A. projects, the estimated cost is given since some of this work is still in progress and final costs are not available.

Disposal Plants

Clayton Plant	42 M.G.D.	$ 830,000
Intrenchment Creek	14 M.G.D.	500,000
South River Plant	6 M.G.D.	400,000
Utoy Creek Plant	3 M.G.D.	180,000
Flint River	½ M.G.D. (not built)	
	Total	$1,910,000

It is estimated that the annual operating costs of all plants will be about $96,000 per year.

Sewer Extensions

Peachtree Creek valley	24.9 miles	$2,400,000
Proctor Creek valley	9.2 miles	770,000
Utoy Creek valley	18.2 miles	996,000
Sugar Creek valley	4.9 miles	254,000
South River valley	13.3 miles	548,000
Other areas	7.5 miles	120,000
	Total for sewers	$5,084,000
	Total for entire project	$6,994,000

The Clayton plant and the Intrenchment Creek plant were designed by Wiedeman and Singleton, the South River plant by Robert and Company, and the Utoy Creek plant by J. B. McCrary and Company, all of Atlanta.

The design and construction of the sewers and the supervision of construction of the sewage disposal plants was done by the construction department of the city of Atlanta, under Clarke Donaldson, Chief of Construction, and W. A. Hansell, Assistant Chief of Construction and Engineer in Charge of Sewers.

DISCUSSION

MR. M. N. HAMMON (Audubon Borough, N. J.): Going back to the graph on the available oxygen, what was the approximate velocity of the river?

MR. SINGLETON: The river is particularly favorable for a rapid flowing stream, and we have no pollution above us here. The river has rocky shoulders and the water is extremely muddy at all seasons of the year, and so there is no chance for growth. In the clear streams the sunshine penetrates the water and there is some growth, but we are not troubled with that.

MR. HAMMON: How do you dispose of your sludge?

MR. SINGLETON: At the Clayton plant we have settling basins and the sludge is digested and dewatered on vacuum filters and then it is sold.

MR. HAMMON: Do you have much demand for that sludge?

MR. SINGLETON: We have not had the new plants in operation very long and our sludge up to now has been limited to what the old plants produced. When we increase our sludge I am sure that we can sell it.

MR. M. W. TATLOCK (Dayton, Ohio): Have you stepped up the rate of filtration?

MR. SINGLETON: We have it running at four million for a part of the day and six million for the balance of the time. I would like to say that even though the old Imhoff tanks were badly overloaded, handling about twice as much as they should, we got about 72 per cent removed even when they were boiling over. We expect to get a high B.O.D. removal from the method we are using now without the use of chemicals. Our B.O.D. load going to the filters would be at the rate of three million per acre and that would not be as much as an ordinary sewage would be at two million; that is, after

it had gone through the tanks the B.O.D. would be less than eighty.

MR. TATLOCK: The reason I asked that question was because we are completing an Imhoff tank and we have been doing some experimental work. We have been operating the tank at the rate of seventeen and one-half million gallons per day and it had a B.O.D. from ninety to one hundred parts per minute. It has been running since the first of January, and at the present time it is doing 86 to 90 per cent removal of most B.O.D. and solids.

MR. SINGLETON: Well, we knew that we were doing something out there in our experiment, but we did not know exactly what it was. Now, we have been wondering whether or not the chemicals are doing us any good at all. There are so many new ideas brought out in the last year or two that we are going to do some practical experimenting before making any statements.

The old question of high rate of filtering is very much up in the air. We may run it six million gallons per acre and get good results but perhaps not quite so good as we would get if it were running at only two million gallons per acre.

In the plant that we are just building, we began with the idea of using chemicals before and after the filter, but we have begun to wonder whether the chemicals are going to operate satisfactorily at that rate with good pre- and after-treatment.

MR. TATLOCK: It might be interesting to note that prior to the beginning of this high rate, the B.O.D. removal was 92 per cent at the low rate of two and one-half million gallons, and when that was stepped up to seventeen and one-half million gallons the B.O.D. removal was 87 to 88 per cent. And, our new sewage filters are so designed that we can carry on the same experiment if we so desire.

Someone asked about the sludge problem in Atlanta, and I want to tell him that the last thing I did before starting down here last Saturday was to arrange for the shipment of fifty tons of sewage sludge to one of the fertilizer plants here.

MR. SINGLETON: Up to now our sludge has been so poor nobody would have it, and that is because the Imhoff tanks were very much overloaded. Therefore, we have not had any sludge to sell, to be perfectly frank with you.

Birmingham's Industrial Water Supply

J. D. WEBB

City Engineer, Birmingham, Ala.

BIRMINGHAM, like all large cities, has grown around its transportation system. It came into existence when the first railroads were developed through the state, and is located at the crossing of the old Alabama and Northern Railway, which is now the trunk line of the Louisville and Nashville Railway System, and the old Alabama and Western, now the Alabama Great Southern, owned and operated by the Southern Railway as a part of their system. The city is located in the heart of the mineral district of Alabama, the city proper being located in two valleys drained by Valley and Village Creeks. The territory was originally settled because of its adaptability for agricultural purposes.

At the time Birmingham was settled, the railroads offered the only means of transportation, as there were no navigable streams in the district. With the development of the railroads, the mineral wealth of the district was discovered and its vast resources of raw materials realized.

Birmingham has always had an excellent domestic water supply, which is owned and operated by the Birmingham Water Works Company, a corporation and not municipally owned. This supply is of excellent quality and has proved adequate for domestic purposes, but as it is a filtered and treated water, the high cost has made it unattractive to industrial users. The advertised rates of the company are as follows: the first million gallons, per month $161.25; the next 14 millions or any part thereof, $90.00 per million gallons; the next million gallons or any part thereof, $80.00. The next 15 million gallons or any part thereof is at the rate of $70.00 per million gallons; and all quantities in excess of 45 million gallons per month are sold at the rate of $60.00 per million gallons.

Except for this supply, industries now located in the Birmingham district are dependent for water upon their own local water supply developments, which vary in size from small pumping stations located on streams immediately adjacent to or near the respective plants, to the central water works supply of the Tennessee Coal, Iron and Railroad Company, which is drawn from the impounding

reservoir of this company in Village Creek. In periods of drought the problem of obtaining a sufficient quantity of water becomes a very acute one for several industries. The quality of water available is far from satisfactory, and as more industries are developed this condition will become more acute.

Quite a long time ago the industrial interests in the Birmingham district realized the necessity of securing additional water for manufacturing purposes, as all sources of supply of raw water had been utilized by existing plants. The Tennessee Company pioneered in this activity.

In 1911, in order to enlarge their plants, the Tennessee Company constructed an impounding dam on Village Creek, creating a storage basin. As an additional supply, water pumped from the mines and air shafts of their mining properties in this drainage area was stored in what is known as Bayview Lake.

The main supply line from this source is a fifty-inch steel pipe put in operation at the time the plant was constructed, delivering the water to a reservoir located above and adjacent to their properties. This source of supply has been in use ever since. The steel pipe line is still in excellent condition, as shown by a recent inspection.

All other industries have been forced to secure their water by a variety of means, pumping from both Village and Valley Creeks, wells, quarries, mines, and any source where any water was available. A survey was made to determine whether all available local sources of cheap water had been utilized. This survey developed the fact that when all existing plants were in operation, an actual shortage of water was inevitable, and that all available water was being used, circulated and cooled, then reused many times, and wasted in the creeks, where it flowed to the next plant to be used once more in a similar manner. This process continued from plant to plant until the water became totally unfit for use.

Sources Investigated

In 1928, the problem of securing additional industrial water was investigated by an organization of industrial leaders, looking toward a supply for the entire district. This organization was headed by H. S. Ryding, who was at that time president of the Tennessee Company. A. Clinton Decker, an engineer in the employ of the Tennessee Company, was selected by this committee to investigate all available sources of supply.

His investigation covered a possible supply to be secured from the Coosa River, another from Slab Creek and the Tennessee River, and a third from the Locust Fork of the Black Warrior River. His report showed that water could be secured from the Coosa River at an estimated development cost of $10,032,400, on a basis of 250 million gallons per day at an average cost of $27.05 per million gallons. The same amount could be secured from Slab Creek and Tennessee River at an estimated cost of $9,517,200.00, with 58 per cent of the water pumped from the Tennessee River into the impounding dam on Slab Creek. The estimated cost per million gallons delivered from this source was $18.20 when consumption reached 82 million gallons per day; $22.00 when it reached 100 million gallons per day; and $26.25 when it reached 150 million gallons per day. This difference in cost was brought about by the necessity of operating a pumping plant from the Tennessee River to replenish the supply in Slab Creek reservoir.

Another source of supply considered at this time was from Locust Fork of Black Warrior River. The estimated cost of this project was $16,276,600. This source would have provided a gravity flow into the district with the construction of a dam on the Locust Fork. The estimated cost per million gallons on this project when the consumption was 100 million gallons per day was $36.85; for consumption of 150 million gallons, $24.55. This project was based on a two-stage construction program, the initial stage being based on 100 million gallons per day capacity. If the consumption were reduced to 60 million gallons per day, water could be delivered at $30.00.

These estimates and studies were considered by the industrial committee and an attempt was made to form a corporation for the construction of such a plant. They were unable to make progress along this line, as we were entering a period of depression and financing proved difficult.

At this time the industrial committee board was merged with the local Chamber of Commerce and the project was taken over by the Industrial Division of the Chamber of Commerce, but with no greater success.

In 1932 it was proposed that the plant be constructed by the city. The President of the City Commission appointed an Engineering Commission, composed of the city engineer, Oscar G. Thurlow, formerly connected with the Tennessee Company and Alabama Power Company, and A. Clinton Decker, to make further studies

and report on the feasibility of the plan. This Commission made further studies into the available sources of supply and considered three sources as being most desirable.

The first source was a possible supply from the Warrior River near Reed's Ferry, by building a pumping plant at this point and pumping against a 400-foot head to a reservoir located just west from the city limits, and bringing the water through the industrial area of the city. The second possible supply involved pumping against a 450-foot head from the Coosa River. The third supply investigated was the Blackburn Fork of the Warrior River, available by constructing an impounding dam and bringing the water into the city from that location.

The Engineering Commission recommended the Warrior River supply because of the low initial cost—$3,196,285, based on a 60 million gallon capacity.

The investigation of the Coosa River supply was abandoned in the early stages without any actual estimate of cost because of the distance which the water would have to be conveyed and the difficulty in crossing the mountainous region between the Coosa River and the Birmingham district.

The Blackburn Fork supply was gone into more thoroughly and an estimate of cost made on a basis of 60 million gallons per day capacity from this site. The original estimated cost was $4,937,144.

Application Made to P.W.A.

The original application for the Warrior River supply was submitted to the Public Works Administration during 1933, and was one of the first projects submitted to the P.W.A. in Alabama. The state administrator questioned the soundness of the project and was unwilling to make a favorable recommendation, but finally agreed to submit the project to Washington for an investigation.

It was necessary that the source of supply be approved by the War Department. Application was filed and a day was set for a hearing for approval of the project. At this hearing, it developed that the transportation interests on the river were opposed to the securing of the supply from Bankhead Lake above Lock 17, claiming that there was insufficient water for lockages for transportation purposes in the dry seasons and that any water taken from this lake would interfere materially with river transportation. In the course of this hearing, it was evident that the permission would not

be granted. The city's representatives asked for a recess in the hearing. At the noon hour, we contacted the transportation delegation. At this conference, it was agreed that if our application were changed to secure the water from the Blackburn Fork where the plan called for the construction of a storage reservoir, the water being diverted finally into Bankhead Lake, adding an additional supply for lockage purposes, this delegation would join forces and request permission to construct the Inland Dam. Before reconvening in the afternoon session, our application was changed to the Blackburn Fork location for the source of supply. In due time, after this hearing, permission was secured from the War Department to secure the water at this point.

The revised estimate of this project called for the expenditure of approximately seven million dollars. After the report of the P.W.A. investigating committee, considerable doubt was expressed by Washington as to the financial soundness of the project. Revisions were made and the cost was reduced to $5,708,000.

During December 1935, the project was finally approved with a loan of $3,430,000. In lieu of a grant, the W.P.A. was to furnish materials and equipment, and construct a certain portion of the project, aggregating $2,378,000. It was agreed that the bonds to be issued were to be revenue bonds only.

The original application for the work included funds for making the preliminary surveys for the project, as all estimates had been made from the topographical maps of the Coast and Geodetic Survey with only a small amount of field work to verify to some extent the estimates made from this source. When the application was approved, on January 19, 1936, the city was faced with the task of preparing all plans and specifications and starting work on the project immediately. The City Commission at that time appointed the same Engineering Commission that had been engaged in the preliminary studies to take charge, complete the final design, prepare all plans, and carry the project through to completion.

It was required as a condition of the grant that work be started immediately by the W.P.A. forces. Fortunately we had been able to do some of the field work on the proposed dam site, taking topography over this area to determine the amount of land needed. This work was done by the Alabama Coast and Geodetic Survey.

Realizing that it would take from four to six months to make the necessary surveys for locating the pipe line and to acquire the

right of ways for it, we saw that the most desirable location for the line was along the branch line of the Louisville & Nashville railroad which operates between Birmingham, Oneonta, and Attalla. We felt that the railroad should be particularly interested in this development and it was decided that they should be solicited for a right of way along the northeastern edge of their 100-foot right of way, on which was constructed only one track, along the center. This location meant a great deal to the project, for the railroad could be used for the delivery of the pipe and contractors' equipment and materials during the construction period. Also, paralleling the railroad was a paved highway which would give additional access to the pipe line. We were successful in securing this cooperation and were enabled to start the project immediately.

The principal units of the Birmingham Industrial Water Supply System are:

1. An impounding dam, approximately 195 feet high and 1,100 feet along the crest, behind which there will be formed a lake 7½ miles long, containing 24 billion gallons of water.
2. Supply and distribution line consisting of 42 miles of pipe from 60 to 16 inches in diameter.
3. A distribution reservoir located a short distance north of the city.
4. A chemical adjustment and denaturing plant at which the pH will be adjusted and the water superchlorinated.
5. The laterals from the distribution mains to the property lines of consumers.

Description of the System

The dam is located on the Blackburn Fork of the Warrior River 32 miles northeast of the city. The supply line, 60 inches in diameter, is laid along the right of way of a branch line of the Louisville & Nashville Railroad, which runs in a southwesterly direction into the city.

The catchment or drainage area from which the waters are impounded is 72 square miles in area. The average annual rainfall in this locality is 55 inches. The dam is across a narrow neck of the river gorge and is constructed of rock and earth fill with a concrete spillway of the morning-glory type. The fill quantities involved in the construction of this dam are approximately 940,000 cubic yards rock and 621,000 cubic yards of earth fill.

The spillway is of concrete construction and is located on the east bank of the stream about 100 yards above the up-stream face of the dam.

For stream control during the construction period a tunnel was driven along the east bank of the river below the dam to a point directly under the spillway, thence at right angles back to the stream above the dam with a coffer dam across the stream to divert the flow of the stream through the tunnel.

The main leg of the tunnel which will form a part of the permanent spillway is 870 feet long from the lower portal north of the dam to the shaft from the spillway and is 20 feet in diameter lined with 12 inches of reinforced concrete with a flat section 8 feet wide at the bottom of the tunnel. From this point back westward to the stream, the temporary portion of the tunnel has a 6-inch concrete lining and is 411 feet long. The shaft from the collecting basin of the spillway is 22 feet in diameter with an enlarged section at the base of the shaft connecting with the tunnel, to take care of the swirl of the water passing through it. The elevation of the top of the spillway is 784 feet, which will be the elevation of the surface of the impounded water.

The spillway is composed of two parallel walls following the contour of the bank of the stream. The wall abutting the bank has a vertical face where it abuts the bank with a slope 7 to 10 on the interior face; the outer wall is parallel with a like slope on the basin side and 40 feet from the toe of the inner wall to the toe of the outer wall. The ends are closed by two walls at right angles on the main walls, the bottom of this basin being 340 feet by 40 feet. The shaft is located at the mid-point, the top section of the shaft having the shape of a morning glory. This shaft is 125.8 feet from top of tunnel to bottom of spillway basin. The outside face of all walls is vertical.

The top of the bank wall is at an elevation of 791 feet. The top of the two end walls and outside walls has an elevation of 784 feet which constitutes the spillway, making the actual length of the crest 530 feet. The bottom of this spillway chamber is at an elevation of 756.86 feet, sloping upward from the center towards each end on a 4 per cent grade. The capacity of this spillway is designed with an added factor of safety to take care of all known flood flow conditions. On the outer face of the spillway, there is a

steel trash rack placed for protection from this source of danger.

In addition to this spillway, along the west bank of the river is a safety device consisting of an open spillway along the west end of the dam, protected by walls and paving with a concrete wall across the spillway at the up-stream entrance, the top of this concrete wall being constructed at an elevation 4 feet lower than the spillway on the opposite site of the river.

The original earth on the up-stream face of this wall is excavated to an elevation of 790 feet or 6 feet higher than the permanent spillway on the east side of the river. The crest of the dam is at an elevation of 800 feet or 10 feet higher than the top of the earth at the emergency spillway. The construction of this emergency spillway invites failure at this point in event any trouble occurs with the spillway on the east bank of the river, for as it is 10 feet lower than the crest of the dam, the overflow would naturally pass over this spillway and will erode or carry away the earth to the level of the concrete wall, allowing the escape of the flood through the emergency spillway. The capacity of this spillway is designed for a 500-year flood condition that may come about some time in the future, providing an outlet that will prevent the dam's ever being overtopped by floods. This feature is new in dam construction and it is our belief that it will prove an absolute insurance for the stability of the dam for all time to come.

The mass weight of the dam is rock fill with an impervious clay blanket on the up-stream face. The rock fill portion of the dam is composed of four different sizes of rock. At the center of the dam the fill is wedge shaped with slopes of repose for this class of material approximating one and one-tenth to one foot. From the center towards the up-stream face, the rock fill is made of one-half inch to three-inch stone in its greatest diameter. From the center line of the dam toward the down stream is a similar fill made from stone 3 inches to 15 inches in its greatest diameter. On the up-stream face of this fill is a layer of stone screenings approximating five feet in thickness. At the toe of this fill there is a cut-off wall constructed entirely across the foundation, extending into and approximately five feet above the rock. This cut-off wall is designed to prevent any seepage along the plane of the rock. An additional cut-off wall midway between the toe of the rock and the toe of the clay fill is constructed in like manner. The rock fill is completed on the down-

stream face by placing quarry-run stone on a slope of approximately two to one.

The crest of the dam is 30 feet wide at the top. Beginning at the crest of the dam, clay fill is placed on a two to one slope to the high water elevation of the lake. From this point, continuing up stream, the clay fill is constructed on a slope of three to one. On top of the clay fill hand-placed riprap approximately one foot thick is placed to take care of wave action for the protection of the clay fill. The greatest depth of clay which is at the toe of the rock fill approximates 125 feet in thickness. All rock fill is dumped in place. The clay fill is constructed in 6-inch layers and consolidated by sheep's foot rollers, extreme care being exercised in the selection of clays and in moisture control. Considerable research work has been carried on in connection with the clay fill to determine the quality and moisture content that will give the densest possible fill for this part of the work. Approximating 22 per cent moisture content, the local clays used have made it possible to secure such density that the weight per cubic foot will average 110 pounds, or considerably more than clay in its original state.

The intake for the supply line is a concrete tower constructed above the dam. It is of reinforced concrete, the interior being an octagon shape section, with counterforts on four corners to stiffen the structure. The base of the tower is on the basic sandstone, the top being at elevation 792 feet, which is 8 feet above the surface of the lake, with the 60-inch pipe line leading northward through the base of the dam from the bottom of the intake tower. The pipe is laid in a trench cut in the sandstone and concreted in.

The intake tower is provided with gate valves at the bottom and at intervals higher up. There is provided one 48 by 60 inch sluice gate at the bottom of the tower, two 30 by 30 inch gates at an elevation of 707.75 feet, and two similar 30 by 30 inch gates at an elevation of 730 feet. These gates will allow temperature control of the supply.

The pumping station, when constructed, will be placed on the west bank of the river near the down-stream toe of the dam.

The capacity of the plant is designed for 60 million gallons per day. The pipe line is a gravity line into and through the industrial areas. With a 35-foot draw-down on reservoir, it is possible to supply 35 million gallons daily by gravity. This amount of water will probably be more than our sales will amount to in the first five

years' usage of the plant. Therefore, the pumping plant will be delayed until the necessity for pumping demands its construction.

The 60-inch steel pipe line extends from the dam to within the northeastern section of the city. At this point the pipe line continues in two directions. One line, a 24-inch cast iron pipe, goes eastward and southward through the eastern industrial area, with laterals leading to the industries now located in this area, the size of the pipe at the southward end being reduced to 16 inches.

Westward from the end of the 60-inch steel pipe, a 54-inch line is constructed through the northern industrial areas and continues on to the Ensley district, the pipe stepping down to 48 inches in diameter. Then the pipe line continues southwestwardly through the industrial areas owned by the Tennessee Coal, Iron and Railroad Company to Fairfield, between which points it is 42 inches in diameter. From Fairfield to the Woodward Iron Company's properties is a section of 24-inch cast iron pipe.

In the project there is a total quantity of 139,000 feet of 60-inch pipe; 8,000 feet of 54-inch steel pipe; 34,000 feet of 48-inch steel pipe; 22,292 feet of 42-inch steel pipe; 19,174.33 of 24-inch cast iron pipe; and 7,536.53 feet of 16-inch cast iron pipe.

At a point approximately 10 miles from the city limits, there is located a distribution reservoir of clay fill construction with a capacity of between 65 and 70 million gallons. This reservoir floats on the line and is automatically controlled. When unusual demands are made on the line, additional water will be supplied to maintain the pressures. Also it will serve the purpose of supply during any period that repairs are necessary on the main supply line. At this reservoir, a surge tank or stand pipe, open at the top, is constructed, the top elevation of which is one foot above the elevation of the water in the main impounding dam. The surge line is connected below the cut-off valves for the reservoir, being free to care for surges in the pipe line. The reservoir is located about one-half mile from the main pipe line. At the point below where the distribution reservoir pipe line leaves the main line is located a chlorination and alkalinity plant. At this point the water will be superchlorinated and alkalinity will be adjusted. The superchlorination was made necessary by the requirement of the State Health Department to treat the water to make it objectionable for drinking purposes, as the plant is purely an industrial water supply. This method of denaturing was adopted because it could be done at less cost than some

other method, such as the use of dye, to make the water distinguishable.

The steel pipe is fabricated from ⅜-inch plates made in this district. A contract for the fabrication of this pipe was let to two local concerns, Chicago Bridge and Iron Company, and Ingalls Iron Works. The 60-inch pipe was fabricated from a 96-inch plate with one lateral well and 5 girth wells. The other sizes of steel pipe were similarly fabricated, using the most economical size plate.

After the pipe was fabricated, the interior was coated with bitumastic enamel applied centrifugally. The outer walls were coated by revolving the pipe slowly, the standard length of pipe being 48 feet. The pipes are connected with Dresser couplings. A small amount of special work, of course, was necessary by hand. The pipe line, although a gravity line, of course passes over higher and lower territories and at the apex of all grades automatic air valves are installed. In addition to the automatic air valves, manual air valves were installed at intervals to facilitate the filling of the pipe with water. Of course, the pipe line has been sectionalized with valves and other necessary equipment such as meters, and blow-offs for bleeding the line.

It is contemplated in the future to construct an additional similar distribution reservoir at the lower end of the line to serve in a capacity similar to the original project.

The site chosen for the dam site proved to be ideal from an economic and construction standpoint. The rock quarry is located on the west bank of the stream; it has a face 100 feet in height and lies above the top of the dam, creating an exceedingly short downgrade haul. The clay borrow pits are located on each side of the stream. The close proximity of the pits required only a short average haul.

Method of Financing

The P.W.A. loan agreement provided that an issue of 4 per cent revenue bonds not to exceed $4,000,000 may be issued by the city and that a portion of the project would be constructed by the W.P.A. Of these bonds the P.W.A. agreed to purchase $3,430,000, this amount to be used to cover the purchase of all lands, right of ways, engineering and other overhead costs and construction cost for all work let to contract.

The W.P.A. is to take over and construct a part of the pipe line,

all laterals, the chlorination and alkalinity plant; the distribution reservoir, the construction road from the highway to the dam site about 1½ miles in length, clearing the basin at the main reservoir and moving a portion of the excavation at the main dam in preparing the dam foundation. The estimated cost of this portion of the project is $2,278,000, for which sum the W.P.A. agreed to complete ready for operation, furnishing all labor, equipment, and materials, this to be done in lieu of a grant on the $3,430,000 loan. In other words, the project is a joint P.W.A. and W.P.A. project, being the only project of like nature within our knowledge, and a project in which the city has no liability except that the city has guaranteed the sale of 13 million gallons of water per day. The revenues from the plant must pay the operation cost, maintenance, and all interest and carrying charges, and create a reserve fund adequate to retire the bonds.

The bond schedule shows that all bonds will be retired in 38 years. To provide funds as needed, the bonds have been issued in blocks of one million dollars, in $1000 denominations.

During the construction period, the W.P.A. overran the original estimated cost and additional funds had to be provided. An agreement was reached between the P.W.A. and the city, P.W.A. agreeing to purchase an additional $150,000 of the same type of bonds, increasing the loan to $3,580,000; these additional funds to be used by the Engineering Commission to pay certain equipment rental contracts, material contracts, and other cash obligations of W.P.A. All bonds are revenue bonds and the City reserves the right to call on 30 to 45 days' notice. Another provision provides for registration of bonds at the office of the city comptroller at Birmingham.

Before approval of the project, P.W.A. required signed contracts of prospective customers for a reasonable amount of water. Of course this was difficult to obtain as all this came up during the period of deepest depression. However, the major operators in the district came forward and the contracts were secured for approximately 9 million gallons per day. The city guaranteed the sale of additional water to the extent of 13 million gallons total sales, which amount was considered satisfactory by P.W.A. In securing these contracts, basic rates were established as shown in the tabulation below.

Due to the existence of these contracts, necessarily, the basic rate has been fixed and will remain in force. However, this price for

SCHEDULE OF RATES

	Average Daily Consumption Based on Monthly Motor Readings	Rate per Million Gallons
First	100,000 or less	$70.00
Next	200,000 or less	40.00
Next	300,000 or less	35.00
Next	400,000 or less	30.00
Next	2,000,000 or less	25.00
Next	7,000,000 or less	23.50
All over	10,000,000 or less	22.00

water will be slightly changed by fixed minimum and meter charges. Contract forms, rules and regulations, and meter charges are now being formulated to be ready when the plant begins operation.

ENGINEERING ORGANIZATION

As formerly stated, the Engineering Commission was commissioned by the City of Birmingham on January 19, 1936, when the application for the loan was approved by P.W.A. and W.P.A. The Commission, composed of A. Clinton Decker, O. G. Thurlow, and J. D. Webb, as Chairman, immediately secured the services of Col. A. C. Polk as Executive Engineer for the project. The Engineering Commission and Colonel Polk then set about the task of establishing an engineering organization to design and build the plant. The project was divided into three major activities, namely, design, construction of the pipe line, and construction of the dam.

The organization is as follows:

ENGINEERING COMMISSION OF BIRMINGHAM

J. D. WEBB, *Chairman* A. CLINTON DECKER O. G. THURLOW

A. C. POLK, *Executive Engineer*
ARTHUR J. BLAIR, *Geologist*
W. W. GARRETT, *Soil Survey and Electrolysis*
SILAS H. WOODWARD, *General Consultant*
SANBORN AND BOGERT, *Consulting Engineers on the Pipe Line*
CHARLES P. BERKEY, *Geologist*
J. ELLIS BROWN, *Land Agent*
H. A. POWELL, *Asst. to Executive Engineer*
H. J. PETERSON, *Designing Engineer*
H. E. PECKWORTH, *Resident Engineer at Dam Site*
H. H. HENDON, *Resident Engineer of Pipe Lines*

1 Assistant Engineer at Dam Site	11 Inspectors
4 Electrolysis Inspectors	8 Draftsmen
4 Designers	5 Transitmen
5 Chiefs of Party	6 Chairmen
7 Rodmen	1 Clerk
1 Chief Pipe Line Inspector	5 Stenographers

P.W.A. OFFICIALS

H. S. GEISMER, *State Director*
W. S. MERRICK, *Project Engineer*
W. P. McCONNEL, *Resident Engineer, Inspection Division*

W.P.A. OFFICIALS

THAD HOLT, *State Administrator*
RAY CROWE, *State Administrator*
A. P. MORGAN, *State Administrator*
W. D. TWING, *Local Director*

All of the above-mentioned officials of the several federal administrations connected with the project have cooperated with the Engineering Commission to the fullest extent. This is especially true of Major Merrick with whom most of our problems are handled.

The engineering organization as a whole has performed a difficult job in an efficient manner, completing the design, plans, and specifications in an unusually short time. Plans and specifications were prepared, bids advertised, and contracts let as follows:

W.P.A.—24″ and 16″ cast iron pipe and specials, Feb. 20, 1936	$ 108,505.00
60″, 54″, 48″ and 42″ steel pipe and specials, Apr. 30, 1936	1,121,629.50
P.W.A.—86,000 L.F. 60″ steel pipe and specials, July 11, 1936	983,840.00
Christie, Hutchinson & Burton—Pipe line, Aug. 10, 1936	269,508.00
Walsh Construction Co.—Impounding Dam Construction, Sept. 4, 1936	1,685,231.14

For the dam, completed designs of two types were made, including complete plans and specifications: one, a mass concrete masonry dam; the other, rock and earth fill. Competitive bids were asked and received on both types. The bid contract prices were as follows:

Concrete Dam	$2,291,062.22
Rock and Earth Fill Dam	1,685,231.14
Saving on Rock and Earth Fill Dam	$ 605,831.08

Since the dams were considered of equal stability, contract was let for the rock and earth fill.

The securing of this project was a district-wide activity. All local organizations, industrialists, the Commission of the City of Birming-

ham, the Governor of the State, the Congressmen and Senators took part in negotiations to secure the plant. No particular party or class can be given the entire credit for securing the plant for the city of Birmingham.

DISCUSSION

CHAIRMAN PHILLIPS: This paper reminds me of something that happens every quarter when the water bills come due. We have an old lady who comes to the City Hall regularly and protests her bill, which is always minimum, and her kick is based on the fact that the only time she ever uses water is to make a cup of tea, and that the water should be free anyway. Well, the Superintendent's reply is always the same. He says, "The water is free and you can go down to the river and get all you want of it; all that we are charging you for is delivering it." That is an actual fact; the charge is just for delivering the water.

We have a few minutes for questions. Does anyone wish to ask Mr. Webb a question in regard to his paper?

MR. F. J. HARTMANN (Camden, N. J.): I believe the speaker said that the water being used for residential purposes was too expensive for industrial use. I would like to know just what he meant by that statement. I come from a town where we do not differentiate between the two users. What do you mean by "too expensive?"

MR. WEBB: It is costing us $90 a million gallons, and for very heavy users of, say, about fifteen million gallons, the price drops as low as $60 a million. That is the lowest we can sell it at present.

MR. HARTMANN: What do you anticipate selling it for now?

MR. WEBB: $22 a million gallons.

MR. HARTMANN: Is your water suitable for residential use?

MR. WEBB: No, we are bringing in unfiltered water and chlorinating it. The state health officers require that the water be made unfit for drinking by superchlorination, which makes it not very tasty, but still usable for other purposes.

MR. HARTMANN: They didn't make that ruling to prevent your competing with private plants, did they?

MR. WEBB: We are not competing with the domestic supply at all. We don't sell any water for industrial or domestic use anywhere the Birmingham Water Works Company supplies that service. The only sales we will make will be to some of the smaller towns through which we pass. We will sell them the fresh raw water, and

they will have to filter and treat it and then dispense it themselves. We are not attempting to get into the domestic field at all.

MR. HARTMANN: Is that $22 your cost price, or are you making a profit on it?

MR. WEBB: We are proposing to make a profit on it at that price.

MR. HARTMANN: What percentage, do you know?

MR. WEBB: No, I don't know because we have not started operations yet.

MR. T. R. KENDALL (New York, N. Y.): Sometimes I think the people in the northern communities where there are no heavy manufacturing industries misinterpret the meaning of industrial water supply. For example, the silk industry in New Jersey needs a high-grade water for industrial purposes. But in the case of the steel mills of Birmingham I understand the water is for cooling the rolls and therefore the chemical character does not make any difference. I met with that misunderstanding in discussing this with folks in the north.

MR. HARTMANN: So that the gentleman may not be misinformed, we have an industrial community and one industry takes fifteen million gallons a day.

MR. KENDALL: It is not the quantity, but the quality.

CHAIRMAN PHILLIPS: I think we shall all admit that that work of Mr. Webb's city is certainly economical and he is to be complimented for the manner in which he is doing his job.

MR. WEBB: I would like to make this statement: The supply of water we will have is selected from a sandstone area and it is not very good to begin with, but it is very soft water, which is an improvement on any water available in Birmingham at the present time. All the water there comes from limestone areas and is extremely hard.

Atlanta's Refuse Incinerator

HENRY J. CATES

Chief of the Sanitary Department, Atlanta, Ga.

THAT OFFICIALS of the City of Atlanta had faith in incineration as a safe and economical method of refuse disposal is clearly shown by the fact that in 1894 the first plant was built by the Dixon Crematory Company, with a capacity of fifty tons, at a cost of $12,190. Minutes of the meeting of the Sanitary Committee of July 1, 1895, indicate that a year's operation had been satisfactory and recommended payment of the contract price. Cost of incineration was 34 cents per ton. It is interesting to note that the cost of extra fuel (coal and wood) for the year was $3,554.07.

By 1904 the population of Atlanta had grown to 141,000 which made necessary more incinerator capacity. A contract was let for a plant of 150 tons rated capacity, to be constructed at a more centrally located place, thus reducing the length of haul. Refuse was hauled up a ramp and dumped through an opening at the top of furnace to a water-cooled cradle above the grates. The idea was to dry out as much moisture as possible before the refuse was pulled or raked through the opening in the cradle arrangement to the grates below.

In 1912, with the population increased to 158,000, the installation of a modern plant of 250 tons capacity was under way. Engineers had begun to give serious thought to the many problems connected with refuse disposal. Analysis had shown that mixed refuse carried fairly high heating values and that steam generation held some worth-while possibilities. The plans called for three units each with a capacity of 85 tons every twenty-four hours. Each unit has three cells—each with a grate area of 22 square feet—total grate area of 66 square feet per unit. Refuse is fed from the top through a hydraulically operated door to a moveable grate. Clinkers are dropped into a pit below the grates and then pushed into a car to be carried outside. Air to support combustion is forced under the grates by a turbine-driven blowing unit, after passing through a preheater which heats it to 300° F. by passing it around a series of tubes through which flue gases pass on their way to the stack.

Gases from the furnaces pass into a combustion chamber then to a boiler of water, tube design, with a rating of 9,000 pounds per hour at 200 pounds pressure and 100° F. super heat. The boiler has a heating surface of 2,750 square feet.

Refuse is hauled from the dumping pit to the hoppers above the furnaces with mono-rail cranes and grab buckets.

Current to operate cranes, lights, and other electrically driven apparatus throughout the plant is supplied by two turbine-driven generators of 35 K.W. each. This, with the necessary feed water pumps and feed water heaters, makes a complete steam plant that uses about 30 per cent of the steam generated, leaving 70 per cent for other purposes.

In 1924 the Atlanta Gas Light Company and the city signed a contract for the use of the surplus steam from the incinerator by the gas works. To connect the two plants required a steam line of approximately 1,900 feet—the gas company taking the steam at the city property line and piping to their steam headers. The contract called for a minimum of 260,000 pounds per twenty-four hours at 16 cents per thousand up to 70,000,000 pounds and 20 cents per thousand pounds above that figure; pressure of 160 pounds with a minimum of 50° of super-heat. The contract carried a penalty clause of 4 cents per thousand pounds for all steam below an average of 11,000 pounds per hour.

In January 1925 steam was turned into the Gas Company headers and almost from the beginning the incinerator carried the steam load of the gas works, although the plants were quite a distance apart. This arrangement proved very satisfactory.

For the year of 1925 a total of 79,000,000 pounds of steam was generated from 126,000,000 pounds of refuse. Of this amount 63,-500,000 pounds were sold and 15,500,000 pounds were used by the plant auxiliaries.

The following year 99,000,000 pounds of steam were generated from 143,000,000 pounds of refuse. Of this amount 72,000,000 pounds were sold and 27,000,000 were used by plant auxiliaries.

Atlanta in 1927 had again outgrown its plant—the 250-ton plant which by this time had been in operation thirteen years. Work was then started on a new unit to be built adjacent to it. The contract called for a furnace with a capacity of 100 tons per 24 hours, with 4 cells, each with grate area of 26 square feet, or total grate area of 104 square feet. Other features were a boiler rating of 12,000 pounds

per hour at 200 pounds pressure; superheat of 100°; 5,620 square feet of heating surface; air to support combustion pre-heated to a minimum of 300°; bridge cranes for use in hauling refuse from dumping pit to hoppers above air-operated feed doors; a 50 K. W. turbine-driven generator to supply cranes, lights and other electrical equipment; boiler feed pumps, feed water heater and air compressor. Thus we had a complete unit that could be operated in conjunction with or independent of the old plant. This unit was put in operation in March 1928 and the tests showed all requirements of the contract met with a good margin.

Much water had passed over the dam since the first steam generating plant was completed in 1913, and an attempt was made in 1928 to correct some of the errors in the 1913 design. The most important change was in the ratio of grate area in the furnace to heating surface in the boiler.

At the end of 1928 with the new unit in operation the supply of steam was much greater than the demand at the gas works so it was necessary to exhaust large quantities to atmosphere. To stop this waste another steam line was built from the incinerator to the steam heat mains of the Georgia Power Company, furnishing an outlet for all steam produced at the incinerator.

The ten-year period of 1925 through 1935 shows a gain in refuse of 30.2 per cent; in steam generated, 124 per cent; in steam sold, 102.6 per cent; and a money gain of 138.2 per cent.

With a worth-while revenue and an increasing demand for steam, efficiency of operation became more important. The first step in this direction was to find out something about the make-up of the refuse, the proportion of the various constituents, the heating value, and the moisture content. To determine these facts with any degree of accuracy, samples had to be taken and analyzed at regular intervals.

This was done by mixing the refuse in the dumping pit, taking out a fairly large amount, and dumping it on a clean floor. From the floor it was put on a small shaking screen. Then paper, bread, animal matter, wood, rags, vegetable matter, glass, metal, No. 1 screen and No. 2 screen, were carefully separated and weighed. Two of these samples were analyzed each week, and at the end of each month an average of all the eight samples were dried and ground to pass a 20-mesh screen. Monthly samples were analyzed at

the Georgia School of Technology by Professor Howell for B.T.U. content, volatile matter, etc. Moisture content was determined by taking a 100-pound sample each eight hours and drying it. Values were as follows:

Month	Moisture [a] Per Cent	Heat Value—B.T.U. per lb.[a] Dry Basis	Wet Basis
January	35.37	6250	3600
February	20.92	6881	4761
March	31.52	6524	3926
April	25.20	6387	4108
May	38.94	6197	3161
June samples were ruined and analysis was not used.			
July	58.98	6710	2322
August	53.79	6519	2534
September	41.28	6306	3082
October	31.41	7086	3387
November	36.97	5828	3141
December	40.14	6585	3339

[a] Without metal or glass as fired.

When this work was completed and a study made of past production records, it became apparent that better evaporation should and could be obtained. Since methods of stoking the furnace, together with the amount of air used to support combustion, as well as draft, were important factors, analysis of flue gas for CO_2, CO, and O were made at regular intervals over a long period of time. For this purpose an automatic gas accumulator was installed on each unit and small samples of gas were taken at intervals of about a minute apart. At the end of each eight-hour shift, a sample was analyzed with an Orsat for CO_2, CO, and O. At first, samples showed only 4 to 5 per cent CO_2 which brought a change in stoking, as well as better regulation of both forced and induced drafts. Soon CO_2 percentages began to climb until 11 to 12 per cent were the rule rather than the exception. There was also a very definite increase in evaporation.

The average percentages of the ten constituents were, heating value on dry basis 6,481 B.T.U. per pound, heating value on wet basis 3,397 B.T.U. per pound, moisture content 38.36. It is interesting to note that there is a very small difference in heating value on a dry basis, while there is a very wide difference on a wet basis, indicating

that some method of drying outside the furnace would be of great value.

	Per Cent of Total Refuse	Weight in Tons
Paper	26.32	24,706
Bread	1.00	939
Animal matter	1.60	1,502
Wood	1.59	1,493
Rags, leather, rubber, etc.	2.68	2,516
Vegetable matter	19.66	18,455
Glass	3.83	3,595
Metal	5.40	5,069
No. 1 Screen	10.70	10,044
No. 2 Screen	27.22	25,551

No. 2 Screen includes such things as clinkers, coal, brick, rocks, etc., that would not pass ½-inch screen. No. 1 Screen includes anything that would pass ½-inch screen, which is largely fine ashes and dirt, and carried little or no heating value.

To take out the No. 1 screening would not only increase the capacity of the plant but would also add to heating value of other fuel, with the added advantage of cleaner heating surfaces in the boilers, better evaporation and a saving of some of the time now lost in cleaning furnaces and boilers. The metal removed has no heating value but has a market value.

From the information gained we have set up an experimental plant with vibrating screen, magnetic separator and shredder, but we have not been in operation long enough to obtain reliable data.

From the sale of steam from January 1925 to date, $255,870.16 has been realized.

DISCUSSION

MR. GODAT (New Orleans): Does Atlanta ever have any occasion for using auxiliary fuel to burn the garbage?

MR. CATES: Yes, during the months of July and August we are forced to add 1 per cent of auxiliary fuel. Our experience is that it is not so much for the heating value of the added fuel as it is that some material forms clinkers.

MR. GODAT: Does the total amount of money put into the operation of the plant actually pay for the steam acquired from it?

MR. CATES: Last year our average cost per ton was 86 cents, but by the sale of steam we have reduced that to 41 cents.

The Collection of Refuse:

A Panel Discussion

CHAIRMAN SHAFER: I shall outline the order of our program as briefly as possible, by reading the questions we intend to ask one another. If there are any additional questions you would like to ask, please keep them in mind and an opportunity to ask them will be given at the close of our discussion. Refuse collection is a big subject. Every town has a different angle on the problem and you will find all sorts of answers to any question. For this reason we want you all to participate.

Here are the topics to be covered: What is to be collected; how frequently; collected from what point; are containers furnished by homes; specifications; ordinances; enforcement; separation; collection equipment; loading height; capacity; cover; trailer; length of haul; how relayed to equipment; working conditions of employees; length of working day; route work; details; both sides of street; does driver help; is transfer basket used; single or multiple crew; interchange of container from house to house; special services (restaurants and hotels); business trash; clean-up week; public education; cost systems.

The members of this panel are as follows: WALTER E. ROSENGARTEN, Lower Merion Township, Pa.; JOHN S. FLOCKHART, Newark, N. J.; LEE S. GARRETT, Columbus, Ga.; and DAVID GODAT, New Orleans, La.

What do you collect, Mr. Rosengarten?

MR. ROSENGARTEN: Garbage, ashes, and trash consisting of bottles, papers, and refuse from the home.

CHAIRMAN SHAFER: How about dead animals?

MR. ROSENGARTEN: Dead animals are handled by our police department.

CHAIRMAN SHAFER: Do you handle any liquid waste such as crank-case oil?

MR. ROSENGARTEN: No, we do not.

CHAIRMAN SHAFER: How frequently are your collections made?

MR. ROSENGARTEN: Garbage is collected three times a week in summer and twice a week in winter. Ashes and trash are collected once in two weeks.

CHAIRMAN SHAFER: How is your garbage collected in Newark?

MR. FLOCKHART: Garbage must be drained and wrapped and then placed in the same container with the rest of the refuse. We have not had any trouble with our garbage.

CHAIRMAN SHAFER: In other words, your rubbish and garbage are placed in the same container?

MR. FLOCKHART: Yes.

CHAIRMAN SHAFER: What size container do you use?

MR. FLOCKHART: The maximum size is about eighteen inches in diameter and twenty-four inches high, which holds about twenty-five or twenty-six gallons.

CHAIRMAN SHAFER: What do you do if the rubbish or the garbage is in a container too heavy for the men to lift? Do you refuse to take it, or do you take it and make a complaint?

MR. FLOCKHART: We have had to take it. While our ordinances prohibit our taking material from a container larger than that, we have been taking it. We have not been able to enforce that provision very well.

CHAIRMAN SHAFER: Do you handle your collections of refuse by contract or by municipal forces in Columbus?

MR. GARRETT: We use municipal forces.

CHAIRMAN SHAFER: How do you dispose of your garbage?

MR. GARRETT: The garbage is disposed of in our incinerator and the waste matter in open dump.

CHAIRMAN SHAFER: Do you burn your ordinary rubbish in the incinerator with the garbage?

MR. GARRETT: Yes.

CHAIRMAN SHAFER: Do you require the garbage to be wrapped?

MR. GARRETT: No.

CHAIRMAN SHAFER: Do you require people to drain their garbage?

MR. GARRETT: We have very little wet garbage, although we do not require them to drain it.

CHAIRMAN SHAFER: Do you have to use any auxiliary fuel to burn the garbage and rubbish?

MR. GARRETT: The only time we use auxiliary fuel is during the

summer months. We have the most trouble with watermelons, green fruit, and fresh vegetables. I have inaugurated a method of grinding my stuff so that we do not have to use very much fuel. I use the hammer-mill grinder.

CHAIRMAN SHAFER: Have you ever tried using crank-case oil for auxiliary fuel?

MR. GARRETT: Yes, but I don't use crank-case oil now, because at the very time you need it you will find that there is no flame in the incinerator and in that case you are apt to have an explosion and blow off your top.

CHAIRMAN SHAFER: Do you make your collections by contract?

MR. GARRETT: No.

CHAIRMAN SHAFER: Mr. Godat, have you ever collected by contract in New Orleans?

MR. GODAT: No, we have not.

CHAIRMAN SHAFER: In Pittsburgh we collect both rubbish and garbage by contract, but we are considering building a nine-hundred-ton incinerator. We are advertising now for bids for the collection of garbage and rubbish. We have no ash collection yet, although we anticipate having that within the coming year.

I might mention our unusual method of taking bids in Pittsburgh. We are taking bids on a per capita basis which is changed each year. That, of course, is assuming that a nine- or ten-year contract is entered into. The rate is based on the number of children enrolled in the public and parochial schools. Multiplying that figure by a constant factor of four and one-third determines the population of the city for the succeeding year, so far as the contract is concerned. In addition, the rate is affected by the labor rate. We use the statistics of the United States Department of Labor. For each 1 per cent of increase or decrease in labor cost the contract rate is increased or decreased three-fourths of 1 per cent.

We don't know yet how this is going to work out, and we don't know whether we will actually sublet this work or whether the city will take it over. The chances are we will make a contract, but it will be done with the proviso that we can take it over with municipal forces if we desire.

Mr. Rosengarten, from what sources are your garbage, refuse and ashes collected, and where is the line drawn between household and commercial garbage, rubbish, and ashes?

MR. ROSENGARTEN: All garbage and trash is collected from pri-

vate homes. The commercial waste we consider the results of business activity and we do not take the trash, boxes, and so forth, from the stores. Those are all collected by private collectors.

CHAIRMAN SHAFER: We have a great deal of trouble in our local community with the little grocery stores and the small shops, as our present contract does not include the collection of their type of refuse. The result is that they take this out in their little delivery trucks and dump it into their home containers, and so we take it anyway. However, if they cannot do that they dump it in back lots or in the street and our Collection Department then has a very tough job of it.

MR. ROSENGARTEN: If there is some material put out which we feel is commercial waste and should not be taken, we tie a red tag on the container and then usually the Superintendent tries to visit that party and explain to him that according to our regulations we cannot take such material.

About six years ago the free collections were started. A good many of the householders did not avail themselves of the public collections. I believe that was because we are primarily a high-class residential section. They have private collectors who go into the cellars and remove the material, whereas our collection is from the rear line of the house, but visible from the street, making it necessary for the householder to put the material out in the rear of the house.

Rubbish is collected but once in two weeks. That time of collection solves some of the commercial problems, in that many of the commercial houses cannot retain their material as long as two weeks.

CHAIRMAN SHAFER: Have you adopted a system of ash collection?

MR. ROSENGARTEN: Ash collections are made by township forces starting October 1 and continuing during the winter months. Rubbish and trash collections are made throughout the year.

CHAIRMAN SHAFER: Do you dispose of the garbage by contract?

MR. ROSENGARTEN: The garbage is used to feed hogs. The material is hauled ten or fifteen miles outside the township to piggeries. As a result, we have a very low contract price in our community of forty thousand population. We collect garbage from the entire township and the cost is only $11,700 a year. A few years ago it was three times that much.

CHAIRMAN SHAFER: Mr. Flockhart, do you have ash collection?

Mr. Flockhart: Yes, we have all classes of material collected in the same receptacle.

Chairman Shafer: How do you handle the small stores?

Mr. Flockhart: Under our ordinance we are not required to collect material weighing more than forty pounds, but that ordinance has not been enforced and we have been collecting it from the small stores where the collections are not large.

Chairman Shafer: From what point do you make your actual collections, Mr. Garrett, from the curb or the back of the house, or do you collect from the alleys?

Mr. Garrett: We use all three methods. Some of our streets are 130 feet wide and on those streets we have the garbage put at the property line and use tub collections. On the streets running 90 feet wide, we have it put on the curbs, and then out in the better sections where they have estates running anywhere from two to five acres and there is a convenient driveway, the trucks drive in and collect from inside.

Chairman Shafer: What do you do in the congested areas?

Mr. Garrett: In the slum areas we try to have all of the garbage put in some kind of a container and put out in front. There are a few of our blocks with alleys and we collect from the rear in those cases.

Chairman Shafer: Do you have any tenements in New Orleans?

Mr. Godat: We don't have tenements, strictly speaking, but we do have areas comparable to them, such as the French quarter where one house is adjacent to the other.

Chairman Shafer: I mean three- or four-story walk-ups.

Mr. Godat: Yes, we have those.

Chairman Shafer: Do they have to bring the garbage down and deposit it in the containers on the curb, or just how do they handle it?

Mr. Godat: That is one of our most difficult problems in New Orleans. They are required to bring it down to the curb, but our difficulty in the poorer section is that they will leave the garbage wrapped in a paper out on the sidewalk. They either bring it down or throw it down.

Chairman Shafer: That sounds like Pittsburgh. In our slum area, we actually hesitate to walk along the street because the people in the top floors are apt to throw a bundle of garbage on your head, and we have not been able to stop it. They have nothing

nd you can bring them into court and fine them, but you can't ɔllect anything. You can put them in jail but that does not solve ur problem for us. I think the only solution is to provide them ⁊ith new housing.

That is a very serious matter to us and to other cities as well s Pittsburgh. Our rate of disease in that section is three or four ɪmes as high as in our regular residential districts. You can't tell ⁊hen some epidemic might break out there, and so it is a problem he whole city should be interested in. We must take care of it ome way as it is not just that local section that has to be considered.

Have you had any experience where the people in a tenement hoot the stuff down a slide into the cellar? The sides of such a lide get foul and dirty and are a source of bugs and vermin of ll kinds. We do not have to contend with that in Pittsburgh, but naybe somebody can tell us about that a little later.

We touched on the matter of containers. Do you have any speciications for your containers, Mr. Rosengarten?

MR. ROSENGARTEN: Lower Merion Township's ordinance proides that we shall not have trash containers holding more than our bushels, and the limit of collection from one household is ne hundred pounds. Garbage, of course, is collected separately n the usual containers and there is no question about the weight n that because the collections are made two and three times a veek. The container for ashes must be metal in order to eliminate he fire hazard.

CHAIRMAN SHAFER: Does it have to have a sealed tight top?

MR. ROSENGARTEN: Not necessarily. The ash containers are of one ushel capacity. Garbage containers must be covered.

CHAIRMAN SHAFER: Do the people furnish their own containers?

MR. ROSENGARTEN: Yes, and they put them out near the rear line f the house, except where the houses are so close together that here is no room, in which case they are placed on the street.

CHAIRMAN SHAFER: You have had very little trouble with that ort of thing because you are in a more or less wealthy community, ut how about New Orleans?

MR. GODAT: We have a good deal of trouble on that account. The city ordinance prescribes the regulation size and requires that hey be of metal with water-tight covers and that the container's veight should be such that it can easily be handled by one man.

However, in the poorer section, or the section of the city where you have the boarding houses, they have great big cans and they are tolerated by the city because the question as yet has not been solved.

Another thing, in the poorer section the people wrap their garbage in a piece of paper and put it out on the curb and dogs come along and tear it open, or some drunk comes by and kicks it into the street. That's another difficulty.

CHAIRMAN SHAFER: What attempts do you make to enforce your ordinance?

MR. GODAT: When we find a condition of that sort we immediately send an inspector to the person's house, caution him about it and inform him that he is subject to a twenty-five dollar fine. In the majority of cases that is fairly efficient.

CHAIRMAN SHAFER: Under what department of your municipal government are collections made? Are they made from the Sanitary Department or the Department of Public Works?

MR. GODAT: Under the Division of Public Works.

CHAIRMAN SHAFER: Do you have a separate bureau handling all refuse collections?

MR. GODAT: For garbage we have a divided collection under one Superintendent, and for the collection of trash we have another Superintendent, but they both function under the Deputy Commissioner of the Public Works Department.

CHAIRMAN SHAFER: Does that same organization handle street collections too?

MR. GODAT: Yes.

CHAIRMAN SHAFER: In Pittsburgh we have the collection of garbage and rubbish under the Bureau of Health and Sanitary Department, and street cleaning under the Department of Public Works, and so it is entirely a matter of cooperation within the department to get results. You can imagine that we have some pretty tall scraps at times.

This year we are planning to combine street cleaning and collection and disposal of all municipal waste under one bureau or one department. We believe that that is the best and the most scientific way of handling the whole proposition. The present system has been unsatisfactory, but we hope it will be better in the future.

Now, I want to touch on the question of separation in the house,

where you have ash collection, rubbish collection, trash collection, and garbage collection. That is a big subject and one that takes a good deal of study.

MR. GARRETT: We take anything we have. We take up ashes and all non-combustible material once a week and this is all put together with the shrubbery refuse collection, and so forth, and is all taken to one place and burned. In certain sections, owing to the fact that our garden clubs have a long flowering season of eight or nine months, we have so much refuse of shrubs, flowers, and the like, that we combine our route and take the garbage in the cans to the incinerator, and pick up the shrubs, flowers, broken limbs, and so forth, and dispose of them on the top of the dumps. Also, any building material that comes from just ordinary repairs where the amount is only about a couple of wheelbarrows full is taken along with our rubbish.

CHAIRMAN SHAFER: Do you take hedge trimmings and Christmas trees after the holiday season?

MR. GARRETT: Yes. We have so many trees that we have to move them. If we depended on private collections our alleys and streets would be blocked practically half of the time.

CHAIRMAN SHAFER: Mr. Flockhart, what type of equipment do you use in your handling of refuse?

MR. FLOCKHART: At the present time we are using large Mack trucks of sixteen and two-thirds cubic yards capacity. We have the open type truck that is covered with a canvas when the material is taken to the dump.

CHAIRMAN SHAFER: How do you load the trucks?

MR. FLOCKHART: We have three loading levels. There are two doors on each side and the floor of the truck is fifty inches high, the next loading level is six inches above that, and that is further divided into two other levels. The extreme height is ninety-eight inches.

CHAIRMAN SHAFER: Will you describe that a little more fully, please?

MR. FLOCKHART: The side of the truck has three panels; the center panel has two doors and these doors are closed or open when different heights are secured. Our first loading height starts at about fifty-six inches and then that door is closed and that adds half of the remaining distance. Then when the upper door is closed we have the rest of the space right up to the top of the body.

CHAIRMAN SHAFER: How do you get the containers up to the top section?

MR. FLOCKHART: They are thrown up by two of our men. That is done at the top level, but very frequently we load about two feet above the top of the collection vehicle. This is for everything, as we have combined collections—ashes, garbage, rubbish, and combustibles.

CHAIRMAN SHAFER: Do you send your garbage to the incinerator?

MR. FLOCKHART: We do not. Newark has twenty-one miles of land of which approximately 20 per cent is meadow land which we are filling and reclaiming. A part of it which has been filled in is now being used as a plant site for the Westinghouse Electric Company.

CHAIRMAN SHAFER: After these big trucks are filled, how do you dump them? Are they regular dump trucks?

MR. FLOCKHART: Yes, they are regular dump trucks with underbody hoist, and they are taken right down to the dumps. We have constructed regular roads there in the last two or three years.

CHAIRMAN SHAFER: Do you dump everything together?

MR. FLOCKHART: Yes.

CHAIRMAN SHAFER: Do you attempt to burn any of the refuse that is objectionable?

MR. FLOCKHART: We are very careful about the way we dump. We do not permit any fires and we have laid out a water line to control it. We are right on State Highway 25 which is one of the busiest highways in the country, and also adjacent to the Newark airport, and so we have to be extremely careful of fires.

CHAIRMAN SHAFER: What do you do about putrefaction and odors?

MR. FLOCKHART: We have not been bothered with that. We have insisted that the garbage be wrapped and we have not had two or three complaints in the last two or three years. There is a number of private dumps, and particularly the one near the skyway, which are objectionable, but we have no control whatever over those. The city dumps, however, are conducted in a very excellent manner, we think, and as a matter of fact we have graded and landscaped about 18 acres and laid out a ball park, covered with grass with W.P.A. labor.

CHAIRMAN SHAFER: Mr. Rosengarten, what is your practice in Lower Merion Township?

MR. ROSENGARTEN: In regard to the truck for collection of trash, we were using a two and one-half to three-ton truck with ten cubic yards capacity. However, in the last year we purchased two trucks with a ton and one-half capacity with the same size body, ten cubic yards, and find that we can operate those lighter trucks for about six cents a mile as against eleven cents a mile for the larger trucks. They also make better time and we feel we have been able to cut down the cost of the collection.

The material is hauled to a dump and formerly we dumped over the sides and from time to time we have been troubled with fires of the burnable material that was buried. Since there are houses within a quarter of a mile, there were some complaints. In the last few years, in order to eliminate these, as fast as the material comes in we have been spreading it over the top surface of the dump and once a day setting fire to it. It burns off rapidly and then is pushed over the face of the dump with a snow plow.

CHAIRMAN SHAFER: Do you use trailers at all?

MR. ROSENGARTEN: No, we have not used trailers. Our average haul to the dumping point is about three miles, and we felt that the use of the smaller trucks in making the trip has been as economical as could be expected.

CHAIRMAN SHAFER: Mr. Garrett, have you anything to add?

MR. GARRETT: The only thing I have to add is that I have also tried the ton and one-half trucks as against the two and one-half trucks. We are now using the two and one-half ton metal body trucks with a capacity which can be increased by means of detachable sides from six to fifteen cubic yards when you get into the bulky stuff. We found that we were not able to prevent excessive wear in the brakes or the clutches in the lighter trucks because of the constant starting and stopping, and the repairs were a very costly business.

CHAIRMAN SHAFER: Do you have a hilly country or a flat country?

MR. ROSENGARTEN: We have quite a few hills and we have been operating the lighter trucks only for one or two years.

The garbage is collected in water-tight bodies with covers, and hauled about ten miles to piggeries. In some cases the garbage is transferred to larger trucks for the long haul to the piggeries.

CHAIRMAN SHAFER: How do you make the transfer?

MR. ROSENGARTEN: That is done by hand shoveling by the contractor.

Chairman Shafer: Mr. Godat, do you have any comments to make on truck equipment?

Mr. Godat: Our system differs very much from what has been described. None of our equipment would fit your conditions. New Orleans is spread out over a very large area, and consequently the disposal of the refuse is not concentrated but is separated into five or six different districts. We have four incinerators on one side of the river and one on the other side. That means that the collection is relatively small and the haul is short. We use trailers with two 2-cubic-yard removable bodies mounted on them which are picked up at the incinerator and removed completely. Empty bodies are then placed on the truck.

Chairman Shafer: What do you do about the containers? Are they cleaned every night?

Mr. Godat: No, they are not. That is something we have been working on and looking forward to for the past year. We have built one steam cleaning apparatus and bought one, and we hope in the coming year to put wash racks at each of our plants for the purpose of removing anything lodged in the containers and cleaning them out about three times a week.

Chairman Shafer: Have you had much complaint about the odor?

Mr. Godat: Our tanks are made of metal with all seams welded. They are dumped directly into the incinerator within a short period after the collection is effected, so the smell is not particularly noticeable. They are covered all the time.

Chairman Shafer: Have you ever gone into the question of consolidated containers? I am speaking now about the refuse and garbage. There are certain types of equipment on the market in the European countries which have mechanical compressors which force out some of the liquid and at the same time compress the mass of material picked up. They make it possible to carry away a bigger load.

Mr. Flockhart: We have not gone into that very exhaustively as we have just bought twenty-two new trucks, but we have so much to haul five and one-half miles that we believe the open-body type of equipment we now have is as economical as we can get.

Chairman Shafer: What about the working conditions for your employees? Do you pay your men by the hour, or by the day, and do you pay them for overtime?

MR. FLOCKHART: Our men are paid for an eight-hour day and they receive 60 cents an hour or $4.80 per day. The average time it takes to make a collection is from eight to ten hours in the winter time. They must finish the route. We have found that in no case have any of our men been able to make the collection in less than eight hours. If we find that we are getting down to the point where it is taking less than eight hours, we simply cut off an extra man. Each day the man in charge of the district makes an estimate of the number he is going to require the next day and if he needs only eight or ten men, he tells one or two men to stay off, and we do not have to pay them.

CHAIRMAN SHAFER: How many men do you send along with one of the big trucks for loading?

MR. FLOCKHART: We are figuring on two and one-half men to the truck and in our ordinary district which has three trucks, there will be four pullers sent out.

CHAIRMAN SHAFER: Do they go ahead of the trucks?

MR. FLOCKHART: Yes. They start out about an hour or an hour and a half before the regular collectors start. They bring the material out from the rear and set it on the curb.

CHAIRMAN SHAFER: Do they throw it into the truck, or do you have a different crew for the lifters?

MR. FLOCKHART: They do not throw it into the trucks. These men work about nine hours and get paid for eight hours. It takes them about nine hours to pull that stuff.

CHAIRMAN SHAFER: How do you get the empty cans back?

MR. FLOCKHART: The empty cans are returned to the property line. We put them back to the sidewalk or the building line.

CHAIRMAN SHAFER: Does that work out all right? Do you have any complaints?

MR. FLOCKHART: No, none at all.

CHAIRMAN SHAFER: Mr. Rosengarten, what is your practice?

MR. ROSENGARTEN: We use a driver and three men to each truck. The driver is paid fifty cents an hour for a ten-hour day while the men with him get forty-five and fifty cents an hour for a nine-hour day. The driver is given the extra hour because we figure half an hour is consumed in the morning and a half hour in the evening getting his truck and picking up the men and then delivering them back somewhere in the general vicinity of where they live.

The township covers about twenty-five square miles and it is usually necessary on the way back from the dump to circle around on a route a few miles in order to drop the men off within the vicinity of their homes. The driver is expected to help load the truck when the stop is long enough to justify it. One man is on the top of the load receiving the barrels and containers as they are thrown up to him. And, when the truck is off to the dump, the men go ahead and bring out the material to the curb.

CHAIRMAN SHAFER: You say you pay your men forty-five cents an hour?

MR. ROSENGARTEN: Yes, some forty-five and others fifty cents an hour.

CHAIRMAN SHAFER: We are paying sixty-two and one-half cents an hour for common labor.

MR. ROSENGARTEN: There are enough men looking for a job, and enough pressure being placed on us to appoint a few more at that rate, that we have not had any difficulty in that connection. It was forty cents up to two years ago and then it was raised to forty-five cents. The highway labor is forty cents the first year and forty-five after that.

CHAIRMAN SHAFER: Do you pay them for the actual time that they work?

MR. ROSENGARTEN: We pay them for nine hours a day. The township is laid out into eight collection districts. Collection is made once from each district in the period of two weeks. Sometimes the men complete the route a half-hour or an hour ahead of time and they are permitted to go home, but they get paid for the full nine-hour day. That is an inducement for them to push ahead and very seldom do they run over the nine-hour day.

CHAIRMAN SHAFER: Have you ever tried the transfer bucket to save a trip back and forth? That is, taking a can in and bringing the full can out and thereby saving that extra trip?

MR. GODAT: Our people are required to put the containers on the curb and we pick them up from the curb.

MR. GARRETT: Our cans are also put on the curb.

CHAIRMAN SHAFER: We have to go in the back for most of ours. Some of our private scavengers and ash collectors use the transfer system. They go into the cellar, pick up the full can and leave an empty can. They take the full can back to the truck and dump it and then bring that can to the house next door. There is the

danger there of carrying disease from one house to another, and that is objected to in some cases, but they continue the system just the same.

Do you cover your men with insurance, or do you have compensation for your men by an outside company? I am talking about liability insurance.

MR. ROSENGARTEN: We have compensation insurance as required by the state. That covers accidents. If they are injured and off for a period of time they are paid through the state compensation.

CHAIRMAN SHAFER: Are they protected by civil service?

MR. ROSENGARTEN: No.

CHAIRMAN SHAFER: How far down the line do you go with the civil service?

MR. ROSENGARTEN: We have no civil service in the township.

CHAIRMAN SHAFER: Mr. Flockhart, what is your plan for protecting your men on civil service?

MR. FLOCKHART: Our men are under part civil service. All the employees of the City of Newark are under civil service. However, the Civil Service Commission has allowed us more freedom than any other class of labor. Our men are registered, but that is all that is necessary before they are given a job.

CHAIRMAN SHAFER: Are your foremen protected by civil service?

MR. FLOCKHART: Yes.

CHAIRMAN SHAFER: In other words, all of your classifications are covered with the exception of the laborers?

MR. FLOCKHART: That is right.

CHAIRMAN SHAFER: What is the average tenure of employment of your men? Do you have very much political interference? Is your turnover rapid on common labor?

MR. FLOCKHART: We don't have much political interference. The men who are engaged in refuse collection work have to be able to do the work and if a man cannot stand it, then we do not keep him.

CHAIRMAN SHAFER: Mr. Godat, do you have any trouble?

MR. GODAT: The present group of employees have been employed for the past twelve years. They were taken over last year by the new administration and all were required to certify under the Louisiana Civil Service and since that time there has been no change in the administration or change in the personnel of the department.

In other words the civil service law practically declared as eligible the present office holders since they were actually functioning at the tasks they had been assigned to. The Deputy Commissioner of the Department, however, has the right of complete dismissal and of discipline in the case of any employee failing to perform his duty, with opportunity for some redress, of course. However, we have had no cases as yet to test out the civil service under those conditions.

CHAIRMAN SHAFER: If a man is discharged by your foreman, is he entitled under your civil service regulations to a hearing before any body before the dismissal is made permanent?

MR. GODAT: That has never been necessary so far. This civil service law is of recent origin and we have had no experience with it as yet.

CHAIRMAN SHAFER: We have civil service down to and including our foremen and truck drivers, but the laborers are not under civil service and they have no protection whatever. They are subject to removal or dismissal at any time by their superior. Have you any comments to make?

MR. GARRETT: My men all the way down from the City Commissioner are subject to being hired and fired at any time, as we do not have any civil service.

CHAIRMAN SHAFER: Have you ever attempted to work out a task system? I think you have hit a pretty good balance there by having them complete a certain job before their work is finished for the day. You pay them for a certain definite route and they have to complete that route within a specified time. Have you ever had any experience with the actual task basis system? How long have you been working the system you are on?

MR. FLOCKHART: That system has been in force ever since municipal collection became effective and it has grown up through the years.

CHAIRMAN SHAFER: Do you have any "clean-up weeks?" That is, do you have any special times when you clean up a city or make a special effort at it?

MR. ROSENGARTEN: We have a clean-up week in the spring. It is advertised some weeks ahead of time and an effort is made to get people to go through their cellars or yards and make a special clean-up. It appears to be quite successful. However, the clean-up

week has not been as hard on us as it was five or six years ago before we had free public collections. It seems that people are cleaning their places more regularly now.

CHAIRMAN SHAFER: A few years ago Pittsburgh established a clean-up week. Ash collections were not established at that time and we figured that it would take us about three or four weeks to get the stuff away, but much to our surprise it lasted six weeks and cost the Highway Department sixty-two thousand dollars just to take care of all of the extra stuff that came out of the cellars and back yards. We found that in some of the high-class residential districts we would get tons and tons of ashes which were pulled out of the cellar. The streets were loaded so high with ashes that you could hardly get through them. The following year it came down to half that figure because we had taken the bulk of the material the first year.

We are trying to get away from the annual clean-up. The Chamber of Commerce conducts the clean-up, paint-up, and plant-up campaign and we work along with them and take care of all the old bottles and rubbish that have accumulated during the year. However, we are trying to get it on a basis where it will be done every week or month.

What do you do about educating your public as to the proper conduct and handling of your garbage? What are your plans for that, Mr. Godat?

MR. GODAT: After the ordinance is adopted by the Council it is printed and then distributed to each property owner. However, those ordinances went into effect during the days of prosperity. They require the wrapping of the garbage, the use of strictly sanitary watertight cans, and the separation of combustible material from noncombustible material. Then when the depression came along all of that was abandoned and we now pick up the garbage the best way we can. We pick up anything that has been placed out for our men, provided they can handle it. If the men can not handle it, we go to the owner and tell him of the violation of the ordinance and ask him for his cooperation. In most cases we get it.

CHAIRMAN SHAFER: Mr. Rosengarten has just gotten out a number of notices which I think are of considerable interest. I believe he has a few extra ones with him and I am going to ask him to tell you a little about them.

MR. ROSENGARTEN: After the original passage of the ordinance

for the collection of trash, a leaflet was printed showing the various collection districts in the township, of which there are eight, indicating which days the collections are made and the requirements of the ordinance. They were printed in large quantities and distributed generally throughout the township.

Whenever there is an infraction of any rule, we use the little red tag. There are a half dozen of the main infractions listed with a place for a check mark. So, by leaving a copy of the regulations and calling attention to the reason for non-collection on the red tag, we have not had any difficulty in the enforcement of our regulations.

CHAIRMAN SHAFER: Do you attempt to keep any cost data on your work?

MR. FLOCKHART: We try to keep an accurate cost of pulling the material to the curb and then on loading and hauling. The reports are made up every day and at the end of the week we have a pretty fair idea of the cost of each one of those operations in each of our districts.

CHAIRMAN SHAFER: Will the manual the association is preparing cover that point?

MR. FLOCKHART: Yes.

CHAIRMAN SHAFER: What practice is used for the disposition of sea foods? What is your plan?

MR. FLOCKHART: That is treated as regular garbage and wrapped and put into a receptacle with the other material. We are not troubled very much with sea food.

CHAIRMAN SHAFER: We are now going to open the meeting to receive questions from the floor. Are there any questions anyone wishes to ask the panel?

MR. HARTMANN (Camden, N. J.): There is a gentleman here from Jacksonville, Florida, who has inaugurated a system which we are about to put into operation in the City of Camden, to make money out of the collection of refuse. I have rather elaborate plans for our city but I understand that Jacksonville has had their system in operation for about four months. They sell cans, paper, rags, bottles, as so forth, and they do other things there to make money out of the refuse. Therefore, I would like to have this gentleman from Jacksonville give us an outline of just how he handles his refuse so that he can make money out of it.

CHAIRMAN SHAFER: We shall be glad to hear from the gentleman.

MR. N. ULSCH (Jacksonville, Florida): First, I would like to ask

one question. One of the men in your panel made the statement th: he did not approve of crank-case oil for fuel in burning garbag Perhaps in Jacksonville we have a different condition than he ha During the "wet season," as we call the time of the watermelo green vegetables, corn, and the like, we use crank-case oil that w have saved to sprinkle on the garbage, and we do not hav much trouble in burning it that way. I would like to find out ho you handled it.

MR. GARRETT: We also have the watermelon, green vegetable and corn situation, but the way I get around that is by grindin it and depositing all of it, with the exception of the corn husks, i the sewers.

The biggest objection we have to the oil is that just at the tim you need it the most your fire is low. If you do not have a flam and pour oil into your incinerator, or sprinkle the garbage withou having a flame, then when it does ignite you will probably have a explosion which will blow the lid off your incinerator or blow your doors open. I know of several incinerators that have ha such explosions.

MR. ULSCH: We have never had that condition.

With reference to salvaging of garbage, we started back in 1933 operating in connection with our incinerator what is known as a Salvage Department. At that time the market was out a good bit on salvage, but from the beginning of this year we leased our salvage to a concern for $8,200 a year on a three-year period, or a total of $24,600. We worked along with that concern for four months and we found it was not profitable and so we took the contract back and are now handling our own garbage.

Last month we sold rags, bottles, paper, and anything for which there was a market, to the junk dealer and we deposited in the treasury $741.08. This month, October, will run better than that. We have one man who takes care of all the salvage. It is separated into different bins for the different sized bottles, and a bin for rags —that includes mattresses and they bring $1.30 a hundred pounds. We put the mattresses out on bids and let five concerns handling rags in Jacksonville quote their prices, and that was the highest price we received for this month.

The buyers come to the cremator, load up their truck, and we weigh it. Bottles are advertised twice a month and sometimes we sell as high as 100,000 bottles on bids. During one month it

might run as high as 175,000 bottles, including the liquor bottles. However, we can't sell the liquor bottles but we do have a glass concern in Jacksonville and so we break them up and sell them as broken glass.

CHAIRMAN SHAFER: How do you separate the stuff?

MR. ULSCH: We have three paid men at the cremator and the others are what we call "loafers." They live at the cremator and we let them work on the garbage for whatever they can get out of it.

Before the stuff is shoveled, they throw out all of the bottles and rags, and then the balance is disposed of. That is the way it is separated and it is brought down underneath our sheds from the deck. From September 1, 1937, to September 1, 1938, we hope to make between $8,500 and $9,000, which amount is set up in our budget every year as added revenue to go into the general fund to reduce taxes.

MR. FLOCKHART: How much do you pay the men who separate the material that is salable?

MR. ULSCH: They do not get anything.

MR. FLOCKHART: Are you bothered with men going around in the early morning and picking out papers and bottles?

MR. ULSCH: We were, but we have a law now that stops that. When our trucks pick up the garbage, we have men on the trucks who keep a barrel in front of the truck and the cans are thrown into one of these barrels. We use four men with a truck—a driver, top loader, and a ground man on each side of the truck. They throw the material up to the top loader and, as bottles or rags come in, they put those into barrels. When the truck arrives at the cremator they unload the barrels and put new barrels on the truck.

MR. FLOCKHART: Who is responsible for the enforcement of the law against picking in the morning, the Board of Health or the Police Department?

MR. ULSCH: The Police Department, and they cooperate with us very nicely. We have had occasion to have only one man before the court.

MR. JOHN STUCKE (Rochester, N. Y.): Is there any law in Florida in regard to old mattresses being sold as salvage?

MR. ULSCH: We don't sell old mattresses. I meant that we sell the tick from the mattresses along with the old rags, provided that the mattresses have not been condemned by the Health Department. If someone dies from a contagious disease on a mattress we get a

report from the Health Department and that mattress is completely burned.

Mr. G. R. Byrum (Birmingham, Ala.): If these loafers you speak of do not get any compensation and the city acquires all of the salvage, what is their incentive for working on the dumps?

Mr. Ulsch: The men who hang around the deck eat right up there. Now, there may be some objection to that, but the Health Department and our other departments say that it is all right. These are all colored men and if an undertaker's wagon comes in with a suit of clothes on it, the colored fellows get the suit of clothes. They can have anything that they can make use of. Of course, you may shake your head at it, but it works out all right in our community. Every day they have what is known as mull at dinner time. That consists of rice, ham bone, bacon, and everything cooked together. Of course, I have never been to one of those meals but there are about eight of them up there and they seem to enjoy it.

Chairman Shafer: What is your regular labor rate?

Mr. Ulsch: We are paying $2.50 a day to the colored and $3.20 to the whites.

Mr. F. J. Hartmann (Camden, N. J.): Several of you people laughed when this gentleman was describing the conditions at his incinerator, but you can go into any dump in any city of the country and you will find people living worse than that. I have seen them in our own city and we have had to get the police to drive them from the dumps. Go out and see the squatters on your own city dumps and see the conditions there, especially if you have a few hot days.

Mr. Stucke (Rochester, N. Y.): We have a garbage collection system that is unique and it is as good as there is. We still are in the horse-and-wagon age. Each man has a certain route to cover, and just now it is taking him ten hours a day to cover it, but as the season wears off, he will probably get through that route in six or seven hours, but he gets a straight eight-hour day wage for it. Some of those men have worked on these routes for twenty and twenty-two years. They know where every can is and they go back there, empty the garbage into a can they are carrying, and then dump it into the wagon or truck.

We have some political changes up in Rochester, but the garbage collectors are not bothered for the simple reason that we keep our men on the job and they have made contact with the householders. If any politician tries to get rid of one of our colored or Italian boys,

they tell the people on the route who get up in arms and tell these politicians that they do not want them fired. I think by using labor in that way you get a better class of fellows and fellows who will do a good job.

We have three different kinds of trucks. We have five trucks of German origin and they work very satisfactorily. We have five-ton trucks and seven-ton trucks. Our wagons will carry about three tons. They have a capacity of three and one-half to four cubic yards. A man has his team and a route with one man on the wagon. He does his job and any complaints that are received he has to correct, but there are very, very few complaints.

We make special collections from hospitals, sanitariums, and factories. Feeding the garbage to hogs up in the north country is not very satisfactory. We have had some hog men come in and collect garbage and they have lost their entire flock of hogs, and so they have given up that practice.

We have an appropriation from the city manager and we have to live within that appropriation. If we have any surplus, it is put into new equipment.

CHAIRMAN SHAFER: Do you send your garbage to the incinerator?

MR. STUCKE: No, it goes to the reduction plant, which gets a revenue from the fertilizer works where they extract the grease. Just now grease is paying a good price of about seven cents a pound. That tankage is very much in demand and it is usually shipped down to Mr. Flockhart's neighborhood. We have an incinerator, however, and that incinerator furnishes the steam that runs the garbage plant, and so we are getting revenue all the way round. They also do some salvaging, but that is another subject.

MR. H. R. SCHWARZEL (Cicero, Ill.): I have heard these gentlemen tell you about a certain route that they cover and I would like to know how many trucks they have and how many teams and trailers, and what is required and how many loads they direct them to deliver to a dump in one day. I would like to know this so that I can figure out my costs and compare it.

After all, the taxpayer is interested in the cleaning of his alleys and streets, and he wants low taxes. In Cicero we have to pay eighteen cents a yard for dumping. The town collects all garbage outside of the restaurants, etc. We cover the district once a week. Now, some gentleman here said that he covered his district twice a week, and I would like to know how large a town he has and how many

trucks he is operating to cover the district twice a week, and also how many loads a truck makes in one day. I believe he mentioned ten yards to the load and I would also like to know how much it is costing him to dump. I want to compare those figures with our town.

CHAIRMAN SHAFER: Mr. Rosengarten, will you answer those questions?

MR. ROSENGARTEN: We have an area of twenty-five square miles divided into eight collection districts. I said the collection is made once every two weeks and that we have three trucks. The garbage is collected two and three times a week. The truck will average about four loads a day over about a three-mile haul. The districts are so laid out that it takes one day for the three trucks to cover them, with the variation of possibly one hour in the completion of the district.

MR. SCHWARZEL: Does anyone here pay for the privilege of dumping garbage? (None) We dump it in a dry dump and we never have a fire. The garbage is dumped on level land and pushed down with a bulldozer that weighs about ten tons. It runs over the top of this garbage continually after it is dumped, and a year later you would never know the place had ever been used for a dump. Because the material is so compact there is no chance for air to get in and cause combustion.

The ashes, cans, and garbage are all put together, but we pay eighteen cents a yard for this dumping privilege, and so it costs us about twelve to fifteen thousand dollars a year for dumping alone. Our trucks were making six loads a day and they have a certain route to cover and they are supposed to carry only ten yards, but they usually carry from twelve to fifteen yards. Cicero is about six miles square but is very densely populated, with about seventy-five thousand people.

CHAIRMAN SHAFER: What does it cost you to collect?

MR. A. J. KRUPICKA (Cicero, Ill.): I just instituted a new system four months ago and I know I cut down the cost. In the past we have been making five and six loads a day, because they were supposed to make that many loads, but they would take trees and bed springs, etc. and put just a little ashes on top of that and go to the dump and get credit for a load. We were paying eighteen cents for the material that went in there and instead of having ten or twelve yards on the truck, they would have only five or six. Therefore, I sent a checker

out to spend one week with each truck to see how much work was actually being done by one truck, and then I designated a day's work, which was approximately six blocks' work for one truck. Each driver was told that regardless of how many loads he brings in a day he has to cover that territory.

Now I am averaging about two and one-half loads a day, but you can't get an accurate figure on only a four months basis. However, I do know that we are cutting down our costs because our trucks are making only two and one-half trips a day to the dumps and we are cutting down on our gasoline consumption as well as the wear and tear on tires, and so forth.

Right now I cannot give you the actual cost on this system, but I hope in the near future to deliver to you the cost for this operation and to show you the saving.

Mr. Rosengarten: Last year we had 8,200 tons of garbage collected in Lower Merion Township and the cost was $2.20 a ton. Under the new three-year contract we have now, that cost will drop to $1.40 per ton. We figure around 650 pounds to the cubic yard of garbage. On trash we collected 4,315 tons at a cost of $0.52 a cubic yard, estimating about 300 pounds per cubic yard. Ashes collected amounted to 4,424 tons at $1.15 a cubic yard, figuring 800 pounds per cubic yard. The total cubic yards were as follows: 2,800 cubic yards of trash and 11,006 cubic yards of ashes.

Mr. H. D. Bradley (Toronto, Can.): I would like to inquire of Mr. Flockhart in connection with the operation of his dumps if he has had any experience with rats, and what treatment he used?

Mr. Flockhart: We have experienced some difficulty with rats, but we have not had a lot of trouble with them recently. Our fill has now reached a point where it is probably half a mile from a highway. As the dumps are isolated, any rats there may be on the dumps are staying there, and are not coming into the city or the surrounding factories or buildings.

Mr. Bradley: With reference to the overtime these men put in, do you make any provision to pay them for that additional time?

Mr. Flockhart: No, we do not.

Mr. S. M. Weaver (Montclair, N. J.): I realize that I am sticking out my neck on this question as it has been discussed pro and con for years, and that is the question of the towns furnishing the cans versus the individuals furnishing the cans. I know there are a great many problems that seem difficult to overcome if the towns furnish

the cans, such as unauthorized use and unauthorized removal. It seems to me if we look at this thing as an over-all cost we might get a different viewpoint. In other words the people of the town or the city have to furnish the cans whether through a certain exclusive manufacturer, or someone else. They have to buy the cans if they are going to have them, and certainly the town can furnish the cans much cheaper than the individual can buy them. The town can furnish the can for a third of what the individual has to pay for them at retail. There is no question about that.

However, everybody seems to have trouble in the enforcement and use of suitable cans, and I wonder if anybody here has been able to enforce the use of the regulation sized can. There is no doubt that the health of the community will be greatly improved by the use of a special can, that the economy of the service will be improved, and operations be speeded up. I wonder if anyone has any figures to show what the possibilities are of decreasing operating costs by supplying cans and how they may have combatted the unauthorized removal of cans.

Chairman Shafer: We are facing that problem now. We have a population of 690,000 people and the Council has just passed an ordinance insisting on a certain kind of can. We figure that it will be impossible for the people to buy those cans, and we are going to have to go into the problem of buying a lot of them and selling them to the people. I would like to have some comments on that. What do you think about the city furnishing the cans instead of the people, or selling them to the people at a very reasonable price?

Mr. J. E. Root (Cincinnati, Ohio): The only thing I would say in that connection is that if the city furnishes the cans free, you will never be able to keep the householders supplied. We have a similar provision in our ordinance and when the people in the poorer residential district can't afford this particular type of can, we empty whatever kind of can they put out. However, we do not have any trouble in the better residential districts.

Mr. Stucke: A group of women in Rochester discussed this matter very thoroughly and got me to go into the matter of obtaining a price for the cans. At that time I could have bought receptacles at seventy-five cents each. According to the plan, I would have to buy twice as many cans as we needed because when we would take one can we would leave an empty. However, they did not go through

with it for the simple reason that the cans would be used for storing bread or something of that kind.

CHAIRMAN SHAFER: Has anybody here worked out that problem? (No response) Mr. Kendall has kindly consented to make a brief summary of this forum for us.

MR. T. R. KENDALL (New York, N. Y.): I was interested in the number of comments on the wrapping of the garbage. This practice seems to be increasing with great rapidity, due chiefly to the increase in the use of incineration as a means of disposal. Even in the small community where my home is I found in talking with a number of women that they prefer to wrap the garbage even though it does not go to the incinerator because they find it keeps the cans cleaner. Perhaps that is an argument that you can use in your talks.

I noticed that everybody talked about open trucks for the collection of garbage, but I have also noted in my travels that there is an increasing use of the closed truck with some sort of a mechanical device for the raising of the garbage to the top of the truck and compressing it, thereby getting a bigger weight of garbage in your truck. This summer I noticed a truck with an enormous extension over the front of the cab, bringing in large loads of bed springs topped off with about a dozen husky branches that had been blown from trees.

Another subject brought up was the idea of not collecting from the small stores any of the refuse they throw out. It seems to me if I were a store owner I would kick very strongly about that. I am paying taxes and so why shouldn't I have my garbage collected the same as anyone else. Probably I may put out more garbage or rubbish. For instance, a shoe store or a grocery store might put out boxes and papers. But aren't they paying higher taxes on that piece of business property than the chap out on the edge of town in a residential district? That is something to think over.

Then somebody brought up the problem of bundles of garbage being thrown out of windows for the passers-by to catch. You will notice that a lot in the larger cities. Also, in walking through some of the streets in New York City you will see some roomer who has just cooked his meal over a gas jet come out with a very neatly wrapped newspaper and walk along the street and if there happens to be an ash can out in front, he will surreptitiously drop it in. And, now that we are so nicely provided with cans in New York, it makes it very convenient for them to do that. It is not a very

healthy situation, and something has to be done in order to control that illegitimate disposal of garbage.

I was surprised at the mention of hog feeding. I thought that was going out of style. The United States Public Health Service has brought out better methods of testing for trichinosis and found that one hog out of every ten is infected and that it is far better to keep the garbage sterile and not feed it to the hogs to carry on the deadly chain.

I was glad to hear the gentlemen of the panel unanimous in their comment that collection of garbage is a public works project. I had a battle when speaking on this subject in one of the New England states several years ago. The Sanitary Engineer got up and differed with my statement that it was a public service problem and not a health problem. He said, "You ought to sit at the telephone and listen to the complaints come in. Mrs. So-and-So is nearly dying from the stench of the garbage wagons when they go by." We battled for several minutes but when I took a poll of the men afterwards everyone seemed to feel that while garbage left in a home or around a residence is a health problem, its collection is by all means an engineering public service problem.

Someone mentioned these foreign types of collection equipment. It might interest you to know there was a French engineer in my office last week trying to contact somebody in this country to manufacture that plunger type of collection equipment, which one of the gentlemen mentioned. It has certain good features, but we also have some good collection equipment made in the United States.

MR. H. H. HALE (Knoxville, Tenn.): I came into the meeting a little late but I would like to mention the type of equipment we are using. You may have read in the *American City* of new type of garbage collector developed in Knoxville. It was a two-cubic-yard capacity and requires only one man to handle it. We have found that it has cut our cost about two-thirds. We have large buckets of welded steel that hold from two to three cubic yards which we leave behind the stores. They are particularly adapted to heavy collections made once or twice a day. The merchants fill the buckets themselves and we don't have to load the garbage.

This unit has been very economical. The buckets cost about $100 each and the merchants get together and buy them. Sometimes as many as three or four stores will cooperate to purchase one bucket.

We have forty of the buckets out now and most of them are picked up not less than once a day by the two trucks that handle the entire collection.

CHAIRMAN SHAFER: This subject has been very interesting, but the time is getting late now and I am forced to close this discussion. Thank you. (Applause)

. . . Mr. Shafer retired and President Buckley assumed the Chair . . .

PRESIDENT BUCKLEY: Thank you very much, Mr. Shafer, for the very expeditious way in which you conducted the panel discussion.

I have been asked to inquire if any city has suffered from a cricket scourge this year? It so happens that the City of Camden did have such a condition and Mr. Hartmann is interested in that problem. (None)

MR. J. S. CASKEY (Audubon Borough, N. J.): I might say that about three years ago we suffered a cricket scourge. They were all over town, eating the ladies' silk underwear, and the ladies called for help. The little children were suffering from them too. Insect powder was put around and the babies were picking up the dead crickets and eating them. I was nearly insane for a while, but finally we bought some oil and sprinkled the dump and the surrounding lots. Then I purchased several hundred gallons of a good insect destroyer and distributed it free to the homes. We burned the dump and suffered from the smoke for a week or two, but that was in 1933, and we have not had one cricket since.

MR. HARTMANN: These gentlemen may be inclined to smile but just try to go to sleep when you have about six thousand crickets in your basement! These crickets are apt to appear on any dump in the country where raw garbage is dumped. Fruit coming from California spoils in some grocer's store and he dumps that fruit after dark. That starts the crickets and they multiply by the millions. You have no idea what it is until you have had them. If we have a mild winter next year as we did last year, then a number of you are going to be bothered with the same condition, because the mild weather brings them on. I understand Toronto had them, Rochester had them, and a dozen other communities right around our section.

I am just bringing this matter to your attention because I think it should be given some consideration, and particularly by those communities that dump raw garbage in paper on the dumps.

Rates for Small Municipal Utilities

ALBERT P. LEARNED
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THE WORK of establishing utility rates for small municipalities is arranging a schedule of charges which will provide sufficient funds to meet the monthly operating expenses, the semi-annual interest payment on the bonds which represent the cost of the property, to pay taxes or their equivalent and leave enough money on hand to replace items of property as they wear out or are retired by a new machine or device which is economical or more satisfactory. It is of course essential that these rate changes be equitable and reflect the benefits of diversity between classes of users, be simple and yet promotional. They should be high enough only to cover the costs of service outlined above. If the rates do more, the consumer is providing funds for the amortization of the debt and theoretically, if not actually, is buying the property or acquiring an equity in it.

There are two general methods by which a municipality pays for its utilities: either through the creation of a sinking fund collected as a part of the general city tax, or by revenues from the utilities. In the first case the taxpayer becomes theoretically an owner of the property in the ratio of his payment to the total tax collected for that purpose; and in the second case the ratepayer is theoretically the owner in the ratio of his payments to the total payments for service.

When the city builds the property with general city bonds then the ratepayer should pay a sufficient amount to equal taxes and pay interest on the investment. When the utility builds the property by means of revenue bonds then, as the amortization of debt permits, the rate should be lowered for the benefit of the ratepayer who is the theoretical if not the actual owner. In the first case the taxpayer is in the position of a bondholder, and in the second case, the ratepayer is in a like position, and each should benefit in proportion to his contribution to the amortization fund.

In the suggestions that follow on the formation of rate schedules no provision is made to include in a utility service charge sufficient return to provide for all city expenses such as the operation of the fire department, the police department, or the street department.

The customers of the municipal utilities in a so-called tax-free city may pay no taxes as such, but they certainly pay their equivalent in their utility service charges. The tax-free town merely readjusts the tax burden. It may, for instance, relieve entirely a non-resident owner of a business block using no utility service or using another utility operating in the city. Such a practice may relieve a flour mill generating its own power of any tax, even though the city may spend considerable in maintaining passable streets to the mill. In such a community the proprietors of the all-night hamburger stands and like customers take over a considerable part of the tax burden formerly carried by the railroads, factories, and non-resident owners of property.

It is recognized that the administrative branch of municipalities has a reason for shifting the collection of a part at least of the general fund onto its utilities, for the general fund requirements have increased decidedly in recent years—often beyond the taxing power of the city. In such cases the municipal utility has provided an easy way to charge and collect an amount sufficient to provide its needed operating expenses. The collection is usually accomplished with very little or no complaint.

It is of course assumed in these discussions that the municipality pays for such utility service as it may use, so that a fair and equitable distribution of municipal costs may be arrived at between the taxpayer and the ratepayer.

This paper will discuss the establishment of rates for electric, gas, sewer, and water utilities. Each of these utilities presents somewhat different problems for analysis. In any single application of the underlying principles, it will be found that each community has its own conditions that will affect the final rate schedule. However, certain general considerations enter into all rate analyses.

All of these utilities may have approximately the same per capita cost under certain conditions, yet the sewer and water utilities generally have a decidedly lower maintenance and depreciation charge than the electric and gas utilities. This applies as well to operating costs, except in cases where water treatment and sewage stabilization are especially costly.

Fixed Charges

Fixed charges, which include interest on the investment and annual amounts set aside in the depreciation reserve or similar ac-

count, must be carefully determined to insure sufficient funds to meet the interest and retirement costs. As a general rule a 5 per cent return will be sufficient to equal the interest charges on money for a municipal utility. To this must be added the annual depreciation requirements.

The annual depreciation requirements for the respective utilities will approximate the following:

1. Electric utilities from 3 to 5 per cent of the depreciable property, dependent somewhat on maintenance expenditures.

2. Gas utilities from 1½ per cent to 3 per cent of the depreciable property.

3. Sewer utilities (if a pipe system only) one half of 1 per cent. If a disposal system is included, a 4 per cent per annum charge for that portion.

4. Water utility not to exceed 1 per cent on the pipe system and from 2 to 3 per cent on the other items of depreciable physical property.

Where taxes are paid they will approximate 2 per cent of the reproduction cost of the property, and will be included in that amount in these studies.

In spite of all the public discussion of electric rates, the average man too often feels he should be paying the price so often quoted at a fraction of a cent per kilowatt hour representing only the switchboard cost of the total kilowatt hours generated, and at times not including the fixed charges. He is not familiar with the losses of distribution, the investment and operating labor required to deliver the energy to him through the distribution system; nor does he comprehend what the cost of linesmen, service men, meter readers, and office force are. These are all necessary to insure him continuous and satisfactory service and are reflected in the cost of a kilowatt hour of energy delivered in his home or at his place of business. He is unacquainted with the depreciation requirements due to wear and tear and obsolescence or advancement in the arts. He is not familiar with the fact that a certain amount of equipment is available for his use and that if he uses it but 25 per cent of the time, the cost per unit of energy will be much higher than if he avails himself of it for 75 per cent of the time. Load factors mean little to him, yet he can understand that his automobile loses $300 in value within a year. If he travels 3,000 miles in the year, that one item of loss value has equaled 10 cents per mile of travel; while if

he travels 30,000 miles the same loss in value equals 1 cent per mile. In the same way the demand cost per unit is reduced by use.

Classification of Users

Electric customers are ordinarily divided into three general classifications, namely, domestic, commercial, and power customers. The latter is often subdivided into many other classifications, such as rated or demand power, off peak, secondary or primary delivery, etc.

The domestic and commercial customers usually use electric energy because of convenience, while many industrial customers use it only when it is the cheapest source of power. In this case the business is decidedly competitive.

Entering into the rate problems it is necessary to know the annual consumption of different classes of customers and their peak requirements. The average domestic customer in the United States used 718 kilowatt hours in 1936, and on the basis of the usual 250-watt average peak demand per domestic consumer, the domestic annual load factor was 33 per cent, which is higher than in the past and reflects increased refrigerator and other appliance loading.

The annual production of energy per kilowatt of installed capacity was 3,119 kilowatt hours in 1936, or an annual load factor per kilowatt of installed capacity of approximately 36 per cent, or a little more than domestic use. However, the standby equipment comprises a large percentage of the installed capacity and the actual load factor was probably between 50 and 60 per cent.

The national average domestic use of approximately sixty kilowatt hours per month does not mean that most of the customers will use that amount. A study of two cities; one of 12,000 persons and another of 4,000, having a monthly average consumption of forty-nine and fifty-six kilowatt hours respectively, showed 20 per cent and 16 per cent of the customers paid minimum bills. Both showed over 55 per cent of the monthly bills were for less than forty kilowatt hours monthly use. Lowering of rates will increase the use of electric energy somewhat, but it will not as a general rule increase it much beyond what the customer had previously paid as a total for his utility service. Electric refrigeration added to the electric load but it was a transfer of household expense from one item to another.

The ordinary complete electric light and power system for a single town will show a reproduction cost now varying from $45

to $65 per capita. The distribution system alone, including street lighting, will cost from $15 to $25 per capita. The investment per customer will range from $150 to $225, of which the distribution system alone will vary from $45 to $80.

The importance of an adequate depreciation reserve is illustrated in two plants recently studied; one was acquired by the city in 1906 and at the time had 120 kilowatt installed capacity. Today it has 4,250 kilowatt installed capacity and 1,292 horsepower boiler capacity. Since 1906 all of the original equipment has been retired, in addition to other equipment totaling 650 kilowatt of installed capacity and 520 horsepower of boiler capacity, with more to be retired soon. The other plant, built in 1915 with an installed capacity of 270 kilowatts and 450 horsepower boiler capacity, now has 1,620 kilowatts and 850 horsepower boiler capacity. During the twenty-two years this plant has retired all of the original equipment and more, totaling 630 kilowatts of installed capacity and 700 horsepower boiler capacity.

The principal items of costs of electric energy are the capacity, commodity, and customer costs. The capacity cost is primarily a demand charge and represents that part of the plant capacity set aside for the customer. The capacity cost includes the fixed charges on the power supply and primary circuits and approximately 50 per cent of the transformer investment, and includes the operating and maintenance expenses that keep this portion of the property ready to serve. The commodity charge includes practically all of the fuel and lubricating cost and the boiler maintenance. The customer cost includes the fixed charges on 50 per cent of the transformer capacity, the secondary distribution, services, meter, office facilities, and the labor used to operate and maintain the secondary distribution system, meters, and the utilization and commercial expense. The fixed charges on general property are allocated to these three charges. General expenses are allocated to these three charges plus street lighting.

After this allocation of the fixed charges on general property is made it will be found that the fixed charges are allocated approximately 80 per cent to demand cost, 3 per cent to commodity cost, and 17 per cent to customer cost. However, when operation and maintenance expense are added to the fixed charges, the total capacity cost is 50 to 60 per cent of the grand total, commodity cost is 20 to 30 per cent and customer cost is approximately 20 per cent.

After these total costs have been determined the capacity cost is divided by the station peak to arrive at an annual capacity cost per kilowatt, the commodity cost by the total kilowatt hours sold, and the customer cost by the total number of customers.

It will be found that the fixed charges covering interest on the investment, proper depreciation provisions, and a provision for taxes will comprise approximately 50 per cent of the cost of service.

It is impossible to apply the method outlined above to many cases, but it will be shown for a few domestic customers having varying load factors and the same peak demand of 250 watt.

In this example the capacity cost is $42.00 per annum per kilowatt, the commodity cost is $.0065 per kilowatt hour, and the annual customer cost is $12.00 per annum.

Customer annual use in kilowatt hours	718	438	657	876
Peak demand in watts	250	250	250	250
Load factor	33%	20%	30%	40%
Capacity cost per annum	$10.50	$10.50	$10.50	$10.50
Commodity cost per annum	4.67	2.85	4.27	5.69
Customer cost per annum	12.00	12.00	12.00	12.00
Total cost per annum	$27.17	$25.35	$26.77	$28.19
Average cost per Kw Hr in cents	3.78	5.79	4.08	3.22

It will be seen at once that the minimum charge under such conditions should be approximately $1.88 per month. The actual charge is usually about one half that amount. The large user helps to carry the minimum and small user's costs. It will also be noted that the user with a good load factor is entitled to energy at a much lower unit cost than one with a poor load factor.

Relation to Demand Requirements

It is of course desirable to have all customers pay in accord with their demand requirements, but it is impractical for domestic service. Certain efforts have been made to approach this situation by the application of room and area determination of the kilowatt hours that should be included in each block in the rate schedule, but in a modern house with a living room running the full length of the house and many electric light and appliance outlets, the room charge is likely to become ridiculous when compared with the actual demand.

A block rate including three groups of 40 kilowatt hours use per month, and putting the excess over 120 kilowatt hours use in one group, will be found a satisfactory and promotional domestic schedule if the price per kilowatt hour in the first group is high enough to provide its proper share of demand and customer costs. The next groups should drop off rapidly to a low rate for the excess.

A great deal of controversy will be eliminated in the commercial rate if actual demand is not considered up to 5 kilowatts and the demand feature is provided for in part by the inclusion of a larger number of kilowatts in the groups of the block rate. For instance, in place of 40 kilowatt hours per group as used in the domestic rate, the groups in the commercial rate should include from 120 to 200 kilowatt hours per group with the same prices as used in the domestic group. In case of larger users with a demand above 5 kilowatt hours, the group should include 50 hours use per kilowatt of demand.

It is not possible in a general paper to go into power rates, but they should be carefully worked out to be non-discrimatory, produce a profit, and get and hold the business.

The intelligent application of the above basis for arriving at costs of electric energy will result in a fair distribution of the cost burden, tend to promote business, and provide low-cost energy for customers with favorable load factors.

Rural Electrification

The matter of rate schedules for the sale of energy for rural electrification has attracted considerable attention lately. What little opportunity the writer has had to study the problem indicates that the character of the load to be added is probably very similar to the domestic load within the city, and that it is not a particularly favorable load to take on at extremely low prices, especially if it necessitates added equipment. The price offered in several instances has been just about the average switchboard cost for all energy generated at the particular plant.

It is of course argued, and with merit, that a municipality has a definite interest in the social development and improved standards of living of the rural community around it. It is no doubt true that the losses of distribution and costs in rural electrification are high, and in order to deliver energy at saleable rates it must be purchased at a low price.

If a city feels that any sale which brings in some revenue above

fuel and lubricating costs and does not require any other outlay is worth while, then that city can sell on the basis of offered contracts.

It has seemed from our limited knowledge of the situation that it would appear more equitable if the contracts offered had more groups in the block rate. This would protect the seller if the load factor were very low. It must be said that if an unusually good load factor developed, these contracts would prove profitable. It is probably good business for the city to take a part in this development for eventually it may prove a source of satisfactory revenue for the service rendered.

Gas Plant Rate Schedules

The establishment of a rate schedule for a gas utility will depend upon whether it is a manufactured or a natural gas system. In the manufactured system there is the investment in the manufacturing plant plus storage facilities over and above the facilities of a natural gas system. In place of an investment of from \$75 to \$125 per customer in a natural gas system, the manufactured system costs from \$175 to \$275 per customer. The domestic customer of the manufactured system uses from twenty to forty thousand cubic feet of gas per year while the average use of the domestic consumer on a system of natural gas is close to seventy thousand cubic feet per year.

The manufactured gas system has storage which is drawn on for peak loads and the plant can be operated at a fairly uniform rate throughout the day. A natural gas system usually has to take the peak loads as they come and transmission systems are packed at off-peak periods to take care of such conditions.

The gas industry as a whole has not pressed the demand feature in gas rates, and in certain localities where it has been tried, public opposition has been great so that the plan has been abandoned. The public opposition to the service charge as such has caused its abandonment by some companies. However, a high charge for the first two or three thousand cubic foot consumption per month, with a decided reduction in price for any additional amount, has been quite favorably received.

In view of these experiences it is suggested that the minimum monthly charge be kept at practically \$1.00 and that the first one and two and perhaps the three thousand cubic feet of gas used in any one month carry the capacity and customer costs. The excess over the third thousand should carry only the commodity cost

plus a small share of the other costs. The commodity cost in a gas system is a much larger per cent of the final price than it is in the electric system.

In recent years the therm has been given considerable attention as the basis for rates and especially where natural gas with its usual heat content of 1,000 B.T.U. per cubic foot has replaced manufactured gas of 550 B.T.U. per cubic foot. The determination of a rate per therm is not difficult for a price of 20 cents per therm corresponds to $2.00 per M.C.F. of 1,000 B.T.U. natural gas or $1.10 per M.C.F. of 550 B.T.U. manufactured gas.

In establishing a therm rate schedule it is essential that enough therms be included in the first groups corresponding to M.C.F. of gas to take care of the costs.

In order to encourage the use of gas for heating water or houses, in addition to its use for cooking, the rate schedule must be promotional. Gas for house heating, even though it is convenient to use, must be sold at a price which is practically competitive.

Financing Sewage Treatment

The problem of financing the construction and operation of sewer systems and sewage treatment works has often delayed the building of systems and plants which are greatly needed. The initial construction calls for the issuance of securities, which have to be repaid, and the operation calls for a regular monetary outlay.

If no pumping or treatment of the sewage is required, the initial outlay is reduced and the operation costs are very low. However, if pumping and extensive treatment works are required, both the initial outlay and the high operating costs may become a financial load unprovided for in the usual constitutional taxing provisions.

The American public has learned to pay small charges regularly for utility services, and during the last ten years many states have enacted laws which will permit a city to levy and collect a "sewer rental" or "sewer service charge." The federal government through recovery agencies has been quite active in securing enactment of state laws to permit the sewer system to function as the water system —as a utility—with the treatment works for sewage in the same category as the water purification plant.

Approximately thirty states now have statutes, or general constitutional authority, permitting municipalities to charge for sewer service by direct periodical billing. Over three hundred and fifty

cities in the United States are utilizing such charges, although in this total are several instances of privately owned sewer systems.

If sewage treatment is not involved, then the volume of sewage is the consideration of most import; however, when sewage treatment is involved then the cost of service may be as vitally affected by the character of the sewage. For instance, if a small town should happen to have a hog-packing plant or similar loads, it might require enlargement of the sewage treatment works to twice its size for domestic sewage or, in fact, it might be the reason for a treatment plant. Fruit-packing plants, creameries, and launderies may contribute special industrial wastes that require added costs for sewage treatment. In cases where strength of sewage is a basis for charges, the biochemical oxygen demand is the criterion on which such charges are founded. Iowa City, Iowa, determines its rental or service charge by this method.

It is impractical to install meters for the measuring of small sewage flows because of the suspended solids, and the charging for sewage service based on water consumed is not entirely equitable because all water purchased does not reach the sewer; yet it is one of the most widely adopted methods.

The basis of charges for "sewer rental" or "sewer service charge" includes the following or a combination of them:

1. A flat rate charge per sewer connection, per residence or business house, per lot, per lineal foot of property frontage, per square foot of area in homes and commercial buildings, number of plumbing fixtures and type, number of rooms in residences and business houses, or number of persons served.

2. A flat or graduated charge on basis of the water consumption or assessed valuation, or both.

3. A percentage surcharge on the basis of the metered water consumption or of a flat rate water bill, which is at times added to in accordance with the type and size of building, character of sewage, or number of persons employed in an institution.

A number of the rate structures based on installed fixtures classify a vacant lot in the same classification as a minimum installation, and such a charge constitutes a "readiness-to-serve charge," while others have a connection charge that compensates for prior exemptions in payments on the improvement.

If the rate is to cover both construction and operation, then the annual charges must be sufficient to provide for the following:

1. The debt service, which includes interest on and amortization of the funded debt.

2. Operating and maintenance expenses.

3. Billing and collecting, or commercial expenses.

4. A depreciation reserve for depreciable property.

The rate schedule must then be selected which seems best fitted for the local situation. It may be one of the forms outlined above or a combination of them. It is not practical to use a schedule based on water consumption or water revenues when the city is not the owner of the water system.

A recent study of over one hundred and twenty-five towns and cities in twenty-two states showed that twenty-two towns and cities had a uniform annual flat rate per connection varying from $1 to $12, sixteen towns and cities based the sewer rental on a per cent of the water revenues and these varied from 10 to 100 per cent, thirty towns and cities had a flat or graduated scale based on the volume of water used, one city had the charge based on the biochemical oxygen demand, seven cities had a charge based on the type of sewer connection, three on the type of buildings, and over fifty upon the number of plumbing fixtures or outlets, and in some of these cities they had a different charge for different types of fixtures, with minimum charges ranging from $2 to $8 per annum.

The volume feature may become increasingly important as more and more air conditioning units are put in. It may become necessary to limit the use of water for these units to avoid the gorging of sewers and the disturbing effect of results to be expected in a sewage disposal works.

The enforcement of these charges is at times difficult, but where collected by the water department as a part of or with the water bill, enforcement is secured by cutting off the water.

Water Rate Schedules

The establishment of a water rate schedule is not quite so interesting, for water is not a competitive product and aside from increased use for sprinkling lawns, there is little possibility for an increase in sales through promotional rates. In the first place, water rates are relatively simple in makeup. Demand has little to do with the customers' use, for the requirements of the fire insurance bureaus for pumping facilities and storage adequate for fire protection provide more than enough for uses at other times, and a heavy draft

by a single customer has little effect on the operation of the system.

In order to avoid waste and to distribute cost of rendering service equitably, it is of course essential to charge on a volume basis. Very little use is made of the service charges in connection with water works property. Practically all water works rate schedules are in block form with the minimum charge based on a certain consumption in cubic feet or gallons per month, and added blocks of different amounts at decreasing prices per unit of volume.

To increase lawn sprinkling and save trees, many cities have inaugurated a special summer sprinkling rate. It so happens that that is the season of the year when the water system has its peak normally without special inducement. If water is available it is more logical to reflect low costs for increased usage throughout the year.

If hydrant rental rates reflected the entire charge properly allocated to fire protection use, in most cases they would be higher than they are today. However, they have been generally accepted at an annual rental of from $40 to $100, with most of the rates ranging between $50 and $75 per annum. This hydrant rental charge in many cities amounts to practically $1 per capita per year.

Water use in air conditioning has not only gorged sewers in some places, but in cities where the water supply is limited has created a situation that has required the passage of ordinances limiting the use of water for that purpose.

The general scheme used in electric rates to determine costs can be used in determining water rates but with more simplicity, for peak requirements are not generally so important in the water charges.

The preparation of a scientific rate schedule for municipal utilities requires study and an intelligent approach, and it is hoped that this paper may have furnished helpful suggestions as to methods that may be beneficially applied.

DISCUSSION

Chairman Phillips: I cannot help but feel a deep sense of personal gratitude for the fine paper presented by Mr. Learned because I got a great deal from it. It is particularly pleasing to hear a man say the things that ought to be said in these days when the most popular campaign platform for a local alderman up to the highest men in government is to pick on the utilities on the basis of improper rate

charges. I think that paper ought to bring forth some discussion. We have a little time for it and I am sure that Mr. Learned will be glad to answer any questions.

Mr. F. J. Hartmann (Camden, N. J.): In mentioning the smaller cities, I suppose that he was talking about the cities with fifteen to twenty thousand population. In some of the larger cities, such as Tacoma, Kansas City, Kansas, and Jacksonville, they operate their municipal electric plants under three different types of operations, namely Tacoma for use only, Kansas City for profit and service, and Jacksonville primarily for service. Then take a city like Camden, N. J. who pays the fourth highest electric rate in the country who are getting nothing except the actual current for the service they are receiving.

I don't like to take an exception to a speaker, especially about a popular issue, but I come from an industrial city that is being held down because of high utility rates, where the citizens pay taxes twice, once to the municipality four times a year, and again to the utilities twelve times a year. Of course, in the small towns it is different, but when you get into a city of a hundred thousand population and more or less an industrial community, the same facts do not hold good, and I can cite a very outstanding example.

In Newark somebody bought a piece of land and then he sold it to the public service for a hundred thousand dollars. Then when it appears on their books it is shown as an investment of sixteen million dollars. That is not right. They used that price for rate-making purposes.

I don't like to take exception to what the chairman has said, but when I know different, I don't like to sit here and listen to it.

Mr. Learned: I would like to say that most all of this investigation has been on the public side. One of the towns that I investigated was a city of twelve thousand population and it had a municipal plant which was paying sixty thousand dollars a year to the general fund. They were paying that on the grounds that the general fund had purchased the property and it should have a return on that investment. Also, they operated and paid their share of the taxes just the same as though they were privately built, but they were owned by the municipality.

Of course the announcement of those costs is a criterion and you would not get that sort of criterion when you go to towns of a hundred thousand population.

CHAIRMAN PHILLIPS: So far as the chairman's remarks are concerned, I certainly intended only to infer that I hoped rates could be arrived at in the future on the basis of technical information rather than political expediency, as happens so often. It is refreshing to hear a paper like Mr. Learned presented, and personally I hope that the engineer will prevail ultimately in all such matters; that is, that rates will be decided on the basis of proper engineering information. Are there any further questions?

MR. A. H. GUILLOT (New Orleans, La.): It just occurred to me when the gentleman from Camden mentioned the high rate in some of the larger cities, that that was brought on by the politicians more than by the utilities. Frequently, I think, the larger cities make it a practice to collect taxes through the utilities, and for that reason we generally find that the rates are so much higher than in the smaller cities for the simple reason there are so much in taxes collected from them. The utilities are usually used as the line of least resistance to collect taxes.

MR. R. P. BLACK (Atlanta, Ga.): In Atlanta we have had bills passed for a 20 to 30 per cent increase in the water rates to help pay the deficiency in some other department.

Specification for Stabilized Wearing Courses

(Using Calcium Chloride and Binder Soil)

H. F. CLEMMER

Engineer of Materials, Washington, D. C.

Chairman of and Reporting for the Specification Committee on Stabilized Roads for Municipalities *

STABILIZED COARSE AGGREGATE MIXTURES

I. DESCRIPTION

This item shall consist of a dense wearing course composed of an intimate mixture of graded aggregate, binder-soil and calcium

* SPECIFICATIONS COMMITTEE ON STABILIZED ROADS FOR MUNICIPALITIES

H. F. Clemmer, Chm. *Washington, D. C.*	H. J. Love .... *Washington, D. C.*
John Ames .... *Ames, Ia.*	George Oldham ...... *Baton Rouge, La.*
A. T. Goldbeck .... *Washington, D. C.*	Stanton Walker ..... *Washington, D. C.*

chloride,[1] placed on the road and treated on the surface with calcium chloride in accordance with these specifications and in conformity with the lines, grades, and typical cross-section shown on the plans.

II. MATERIALS

1. Graded Aggregate. Graded aggregate shall consist of a mixture of (a) gravel, stone or slag, or combination thereof, composed of sound, tough, durable pebbles or fragments, and (b) sand, stone dust, slag dust, or other inert, finely-divided mineral material, both combined as necessary to give a final mixture which will conform with the requirements given in Section III. Gravel present shall have a per cent of wear of not more than twenty (20), and stone present shall have a per cent of wear of not more than eight (8). Slag shall be blast furnace slag and shall weigh not less than seventy (70) pounds per cubic foot. These properties shall be determined by the Standard Method of Test of the American Society for Testing Materials.

Suitable aggregate present on the road, scarified and, if necessary to meet the grading requirements, blended with new aggregate, may be used as graded aggregate.

In case the graded aggregate is to be all new material, it shall be placed only on prepared subgrade (or base), conditioned to true line, grade, and crown, and specifically approved by the engineer.

2. Binder Soil. This material shall consist primarily of fine soil particles and its binding properties shall be such that it provides the required physical structure and properties to the final mixture, as described in Section III.

3. Calcium Chloride. Calcium chloride shall conform to the requirements of the American Society for Testing Materials D98-34.

III. COMPOSITION

The final mixture of graded aggregate and binder-soil shall be so graded, and the prescribed constituents, prepared as detailed hereinafter, shall be combined in such proportions as to produce a mixture conforming to the following composition limits by weight:

---

[1] During low temperature and slow-drying periods, the incorporation of calcium chloride may be discontinued and the surface method used as described in Section IV-8.

Passing 1-inch sieve[2]	100 per cent[3]
Passing ¾-inch sieve	80-100 per cent
Passing ⅜-inch sieve	50-90 per cent
Passing No. 4 sieve	40-75 per cent
Passing No. 10 sieve	30-55 per cent
Passing No. 40 sieve	20-35 per cent
Passing No. 200 sieve	10-20 per cent

The fraction passing the No. 200 sieve shall not be more than two-thirds of the fraction passing the No. 40 sieve.

The fraction passing the No. 40 sieve shall have a plasticity index between 1 and 9. If the stabilized road is to be used as a base within a year, the plasticity index shall not exceed six (6). Furthermore, to prevent the undesirable combination of a high amount of soil fines and high plasticity index in a stabilized mixture, the sum of the percentage of the material passing the No. 40 sieve and the plasticity index of this fraction shall not exceed thirty-five (35). The liquid limit of the fraction passing the No. 40 sieve shall not exceed the value determined from the Bureau of Public Roads formula: L.L. = 1.6 P.I. + 14.

Liquid limits greater than those obtained from the above formula indicate definitely the presence of the undesirable micaceous, diatomaceous, and peaty substances productive of sponginess and high capillarity. These test values shall be determined by the standard methods of the American Society for Testing Materials (D423-35T and D424-35T).

In case all or part of the graded aggregate consists of slag there shall be a correction made in the graduation of the final mixture, depending upon the weight-volume of the materials used.

IV. CONSTRUCTION

1. Methods and Equipment. The methods employed in performing the work, and all tools, machinery, and other equipment used in handling materials and executing any part of the work, shall be subject to the approval of the Engineer before work is started and, whenever found unsatisfactory, shall be changed and improved as

[2] Sieves for gradation analyses shall have square openings, and shall be the U. S. Standard Series for No. 4 and finer.

[3] Materials of greater maximum size may be used but should never exceed one-third of the thickness of the stabilized wearing course, nor an amount greater than 10 per cent over one inch in size.

required by the Engineer. All tools, machinery and other equipment used must be maintained in a satisfactory working condition.

2. Preparation of Subgrade or Base. (a) *Firm Soil Subgrade.* When the material in the subgrade consists of a firm soil, it shall be bladed or otherwise cut to the final grade and cross-section called for on the plans. If any of the soil thus removed is to be employed in making up the wearing course, this loosened material shall be bladed to the shoulders of the road and left in windrows for subsequent measurement and use.

(b) *Loose, Sandy Subgrade.* Where the subgrade consists of loose, unstable material of a sandy character, it shall be prepared by one of the following methods, after any portion to be used in the final stabilized wearing course has been bladed to the shoulder of the road where it is to be left in windrows for subsequent use:

(1) The loose, sandy subgrade shall be uniformly covered with a layer of soil not less than three inches thick, having a plasticity index between 4 and 12, and this material shall be compacted.

(2) The sandy subgrade shall be covered with a soil which has a plasticity index greater than 15, and in this case it shall be mixed with sand from the subgrade until the combination is not less than three inches thick and has a plasticity index between 4 and 12. Mixing shall be done by means of harrows, after which the mixture shall be shaped and again compacted. The final surface of the subgrade shall be trued up to the grade and cross-section called for on the plans.

(c) *An Existing Road as Base.* An existing base shall be scarified or bladed, or both, if and as directed, to a depth sufficient to eliminate all irregularities of the surface or to obtain material to incorporate in the final stabilized mixture, or to permit any reshaping and necessary adjustment to the grade or cross-section as called for on the plans. Following necessary scarifying operations, the loosened material shall be bladed onto the shoulder of the road for subsequent measurement and use, and the base shall be left free from surface irregularities and shall conform to the grade and cross-section called for on the plans.

3. Placing of Material. (a) *Combination of new aggregate with old aggregate from existing road surface.* Any loose materials present as floats on an existing base, or any materials obtained by scarifying operations, may be incorporated into the final stabilized mixture, either wholly or in part, if found suitable. All such materials shall be

bladed onto the shoulder of the road and left in windrows for subsequent measurement and use.

When the grading of the material thus loosened is found, by sieve analyses and physical tests, not to meet the requirements hereinbefore prescribed for the final mixture, or when additional material is necessary to provide the total thickness called for in the plans, supplemental aggregate shall be delivered and distributed in sufficient quantity to produce, in combination with the material loosened by scarifying and with any necessary binder-soil, a compacted layer of desired thickness.

The loosened material, the supplemental aggregate, the crushed binder-soil, and the necessary calcium chloride, shall then be thoroughly mixed together as hereinafter described.

(b) *All New Aggregate.* When none of the material in the existing road is to be utilized in the final stabilized mixture, or when the stabilized wearing course is to be placed on a new grade, the following procedure shall be employed: The new graded aggregate shall be delivered and distributed in sufficient quantity to produce, in combination with the binder-soil, a desired layer of compacted mixture which will meet all the gradation requirements and physical test properties as hereinbefore prescribed. The new material, the crushed binder-soil and the necessary calcium chloride shall then be thoroughly mixed together, as hereinafter described.

4. Preparation of the Binder-Soil Prior to Mixing with Graded Aggregate. This material, when supplied separately, shall be delivered and spread uniformly on the existing road surface or subgrade. The binder-soil either shall be dried out and crushed on the road surface on which it is spread or shall be prepared off the grade and transported to the job.

Crushing of binder-soil shall be effected by means of rollers or other suitable equipment. When tested by means of laboratory sieves this crushed binder-soil shall meet the following requirements:

Passing a 1-inch sieve	100 per cent
Passing a No. 4 sieve, not less than	80 per cent

Except when directed by the Engineer, or except during actual manipulation, the binder-soil or the mixture of it and the graded aggregate shall be uniformly windrowed along the shoulders.

5. Road Mixed Material. This designation describes the mechani-

cal mixing of the various constituents directly on the subgrade or road base, as contrasted with material mixed in plants.

The graded aggregates and binder-soil, sufficient to give the desired depth of compacted wearing course, shall be thoroughly mixed by alternately spreading and windrowing the materials, or by multiple blade maintainers, or by other approved methods. This mixture shall then be bladed into a uniform windrow on each shoulder of the road, to be redistributed over the road, as specified. During these operations no appreciable amount of subgrade or shouldering material shall be incorporated in the mixture.

When calcium chloride is to be used as an admixture, the following procedure shall be followed prior to the mixing operations described above: The graded aggregates and binder-soil shall be spread loosely, individually or in combination, over the prepared base. Flake calcium chloride shall then be uniformly spread over these materials at the rate of 0.5 pound per square yard per inch of thickness. In no case shall the amount of calcium chloride exceed two pounds per square yard, which limits the maximum thickness to be so treated to four inches. If a compacted stabilized wearing course of greater thickness than four inches is specified, the calcium chloride shall be incorporated only in the upper layer.

6. Plant Mixed Material. This item shall include material mixed either in a central mixing plant or in a portable plant, which operates along the road while mixing. In the operation of either plant the binder-soil shall be reduced to meet the requirements of Section IV-4 or the plant shall be equipped with an auxiliary unit that will disintegrate or shred the binder-soil to a satisfactory degree before mixing with the other ingredients.

The mixing unit shall consist of a pug mill or other effective mixing equipment, which shall produce a uniform finished mixture free from clay balls and uncoated material. If the different materials are to be fed into the mixer unit separately, adjustable feeding devices shall be provided to insure uniform proportioning. This may be accomplished by conveying or elevating units, by weight or volume batching systems, or by other approved methods.

For portable plants the discharging device shall be so arranged and controlled that the mixed material shall be deposited in a windrow of uniform height and width, or in a layer of uniform width and thickness.

The finished plant-mixed material shall contain 5 to 8 per cent by

weight of moisture and at least ten (10) pounds of calcium chloride per ton of mixture.

7. Sprinkling and Compaction of the Road. (a) *Road Mixed Material.* If the mixture of intimately combined graded aggregate, binder-soil and calcium chloride in windrows on the sides of the road does not contain sufficient moisture for compaction when it is to be spread over the base, the addition of water is necessary and it shall be added in such quantity and in such manner that the material will be brought to a satisfactory moisture content.

The moistened material shall then be spread in a uniformly loose layer of correct thickness, after which the road shall be shaped and compacted, using truck graders and traffic, or other trucks or rollers, as directed by the Engineer.

The foregoing operations may be carried on during or immediately following a period of rainfall and the need for artificial water addition thus eliminated. The necessity for water addition and the amount to be used shall be determined by the Engineer in charge.

Should the dry-mixed materials become wet from rainfall while in windrows, the mixture may be bladed onto the road surface and shaped and compacted while drying takes place. Shaping and compaction shall continue until the moisture has decreased to a point at which the mixture becomes hard.

(b) *Plant Mixed Material.* The plant-prepared surfacing material shall be windrowed on the shoulders in the proper quantity per station and then shall be spread on the subgrade or existing base in uniform layers of correct thickness, or it may be deposited directly in uniform layers of correct thickness. Each layer shall be shaped and compacted thoroughly by means of truck graders and traffic or other trucks or rollers as directed by the Engineer.

If the moisture content of the material is not such as to permit the satisfactory compaction of each layer, water shall be added in such quantity and in such a manner that the material will be brought to a satisfactory moisture content. If necessary, layers shall be disked or harrowed during the moistening operations, so as to secure a uniform moisture content.

(c) *General.* Special care shall be exercised during the compaction of the last lift to maintain a smooth surface, a crown of approximately one-half inch per foot, and to avoid the development of low spots or depressions which will hold surface water. Shaping and compaction shall continue until the mixture becomes hard, true to

line, grade, and cross-section. During the first five to ten days, after the road has been shaped and properly compacted, as specified above, it shall be sprinkled and bladed sufficiently often, as directed by the Engineer, to maintain a smooth firm wearing surface.

8. Application of Calcium Chloride to Road Surface. (a) *If calcium chloride has been incorporated in the mixture.* After the road has been compacted and maintained as specified above, it shall be given a final shaping and smoothing and flake calcium chloride shall be spread uniformly over the surface with an approved spreader[4] at the rate of at least 0.6 pound per square yard.

(b) *If calcium chloride has not been incorporated in the mixture.* After the road has been shaped and given its initial compaction, the calcium chloride shall be uniformly spread over the surface of the road at the rate of 1.0 to 1.5 pounds per square yard.

In either case the surface application of calcium chloride shall be made during periods of high humidity, as during the night or early morning hours, unless the surface is in a damp condition from sprinkling or from natural sources. In the latter case, the calcium chloride may be applied at any time.

V. METHOD OF MEASUREMENT

The quantities to be paid for shall be as follows:

1. The number of square yards of constructed stabilized surfacing, including all work involved in this item, the number of tons or cubic yards of stabilized mixture delivered or in place.
2. The number of tons or cubic yards of supplemental aggregate accepted and incorporated in the surfacing.
3. The number of tons or cubic yards of supplemental binder-soil accepted and incorporated in the surfacing.
4. The number of tons of flake calcium chloride incorporated in the surfacing.
5. The number of tons of flake calcium chloride spread on the final road surface.

VI. BASIS OF PAYMENT

The quantities, determined as provided above, shall be paid for at the respective unit prices, as the case may be, bid for the following:

[4] If the drill type of calcium chloride distributor is used, the spreader or baffle board should always be used and should be kept clean so that the distribution of the calcium chloride on the road will be uniform.

1. Stabilized road surfacing, per square yard; stabilized mixture per ton or cubic yard.
2. Graded aggregate, per ton or cubic yard.
3. Binder-soil, per ton or cubic yard.
4. Calcium chloride for purpose of admixture, per ton.
5. Calcium chloride for surface treatment, per ton.

Prices and payment shall be full compensation for furnishing and preparation of all materials, including all new aggregate, and for mixing, manipulating and applying all materials, laying down and finishing the course to profile grade and cross-section, including all labor, equipment, tools and incidentals necessary to complete the item.

STABILIZED FINE AGGREGATE MIXTURES

I. DESCRIPTION

This item shall consist of a dense wearing course composed of an intimate mixture of graded fine aggregate, binder-soil and calcium chloride placed on a prepared sub-base and treated on the surface with calcium chloride.

These fine-aggregate mixtures may be used:

1. For the construction of road surfaces if coarse aggregate is not available.
2. For stabilization of loose sandy subgrades.
3. For playgrounds, tennis courts, and similar surfaces.

A compacted mixture of fine aggregate and binder-soil, conforming with the requirements given in Section II, possesses the resisting powers of the fine aggregate in wet weather and of the binder-soil in dry weather, and is superior to either in all types of weather.

II. MATERIALS AND COMPOSITION

The graded fine aggregate shall consist of sand or stone screenings or slag screenings, or other inert material combined with suitable soil fines to give a final mixture which will meet the following requirements:

Passing ⅜-inch sieve....................90-100 per cent
Passing No. 4 sieve......................75-100 per cent

Passing No. 10 sieve	55-100 per cent
Passing No. 40 sieve	35-70 per cent
Passing No. 100 sieve	25-45 per cent
Passing No. 200 sieve	20-35 per cent

The fraction passing the No. 40 sieve shall have a plasticity index between 1 and 9. If the stabilized road is to be used as a base within a year, the plasticity index shall not exceed six (6). The liquid limit of the fraction passing the No. 40 sieve shall not exceed the value determined from the Bureau of Public Roads formula: L.L. = 1.6 P.I. + 14.

Liquid limits greater than those obtained from the above formula indicate definitely the presence of the undesirable micaceous, diatomaceous, and peaty substances productive of sponginess and high capillarity. These test values shall be determined by the standard methods of the American Society for Testing Materials (D423-35T and D424-35T).

III. GENERAL CONSTRUCTION

There are four practical ways of constructing these surfaces:

1. If a natural mixture of sand and clay is available, it shall be placed on the prepared subgrade, and compacted.
2. If the subgrade is sandy, the binder-soil shall be placed on and mixed with the subgrade material and then compacted.
3. If the subgrade consists of suitable clay, the most economical type of aggregate shall be placed on and mixed with the subgrade material, and then compacted.
4. If the subgrade contains no material suitable for use in constructing the surface, and there is no natural mixture available, then the most economical type of aggregate and suitable binder-soil shall be placed separately on the subgrade, mixed and compacted.

For further details on construction, equipment, mixing, and compaction methods, see Section IV, of Specifications for Stabilized Coarse Aggregate Mixtures.

IV. APPLICATION OF CALCIUM CHLORIDE

1. For Road Surfaces or Bases: After the road has been shaped and given its initial compaction, the calcium chloride shall be uniformly spread over the surface of the road at the rate of .75 to 1

pound per square yard. This is followed by two applications of 0.5 pound each later in the season, each being applied as required to maintain proper moisture content.

2. **For Playgrounds, Tennis Courts, etc.:** After the surfaces have been shaped and compacted, the calcium chloride shall be added either in flake form or as a solution. If the flake form is used the surface shall first be sprinkled lightly before applying the calcium chloride.

If a solution is used it can be accomplished by dissolving the flake calcium chloride in water at the rate of 3 pounds per gallon. The resulting solution shall be sprinkled over the surface.

The calcium chloride in either case will be more effective if the applications are made more often with smaller amounts than if larger amounts are applied less frequently.

From construction experiences and investigative endeavors a set of practical specifications has been formulated, which not only assures a balanced combination of the materials but also furnishes a guide for the construction of these roads.

Specification for
Materials for Stabilized Base Course

I. MATERIAL COVERED

1. This specification covers the quality and size of sand-clay mixtures; gravel, stone, or slag screenings, or sand, crusher run coarse aggregate consisting of gravel, crushed stone, or slag combined with soil mortar, or any combination of these materials for use in the construction of a stabilized base course. The requirements are intended to cover only materials having normal or average specific gravity, absorption, and gradation characteristics. Where materials such as caliche, gypsum, limerock, and water soluble salts are to be used, appropriate limits suitable to their use must be specified.

II. TYPES

2. The following types of base course stabilized mixtures are specified. The Engineer shall designate the type or types desired:

Type A: Sand-clay mortar.
Type B: Coarse graded aggregate.
Type C: Gravel, stone or slag screenings or sand.

III. GENERAL REQUIREMENTS

3. The type or types designated shall conform to the following requirements: (*a*) *Type A*. The materials for this type shall be composed of natural or artificial mixtures of clay or soil binder and gravel, sand or other aggregate proportioned to meet the requirements hereinafter specified. The aggregate retained on the No. 4 sieve shall be composed of hard, durable particles and shall be free from injurious or deleterious substances.

(*b*) *Type B*. The material for this type shall consist of natural or artificial mixtures of gravel, stone or slag and soil mortar so proportioned as to meet all the requirements hereinafter specified.

The coarse aggregate shall consist of clean, hard, durable particles of crushed or uncrushed gravel, stone or slag free from soft, thin elongated or laminated pieces and vegetable or other deleterious substances. It shall be hard and durable enough to resist weathering, traffic abrasion, and crushing. Shales and similar materials that break up and weather rapidly when alternately frozen and thawed or wetted and dried, should not be used.

The soil mortar shall be that portion passing the No. 10 sieve and shall be composed of soil binder and granular material such as stone or slag screenings or sand.

(*c*) *Type C*. The materials for this type shall be composed of gravel, stone or slag screenings or sand or mixtures thereof proportioned to meet the requirements hereinafter specified.

The material shall be composed of hard, durable particles, free from injurious or deleterious substances, uniformly graded from coarse to fine.

IV. DETAIL REQUIREMENTS

4. The type or types designated shall conform to the following requirements:

Type A

Passing 1-inch sieve	100 per cent
Passing No. 10 sieve	65-100 per cent

The material passing the No. 10 sieve shall meet the following requirements:

Passing No. 10 sieve	100 per cent
Passing No. 20 sieve	55-90 per cent
Passing No. 40 sieve	35-70 per cent
Passing No. 200 sieve	8-25 per cent

The fraction passing the No. 200 sieve shall not be greater than one-half the fraction passing the No. 40 sieve. The fraction passing the No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 6.

Type B

	B-1 *1-in. max. size*	B-2 *2-in. max. size*
Passing 2-inch sieve		100 per cent
Passing 1½-inch sieve		70-100 per cent
Passing 1-inch sieve	100	55- 85 per cent
Passing ¾-inch sieve	70-100	50- 80 per cent
Passing ⅜-inch sieve	50- 80	40- 70 per cent
Passing No. 4 sieve	35- 65	30- 60 per cent
Passing No. 10 sieve	25- 50	20- 50 per cent
Passing No. 40 sieve	15- 30	10- 30 per cent
Passing No. 200 sieve	5- 15	5- 15 per cent

The fraction passing the No. 200 mesh sieve shall be less than one-half of the fraction passing the No. 40 sieve. The fraction passing the No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 6.

Type C

Passing ¾-inch sieve	100 per cent
Passing No. 4 sieve	70-100 per cent
Passing No. 10 sieve	35- 80 per cent
Passing No. 40 sieve	25- 50 per cent
Passing No. 200 sieve	8- 25 per cent

The fraction passing the No. 200 sieve shall be less than one-half of the fraction passing the No. 40 sieve. The fraction passing the

No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 3.

V. MOISTURE CONTENT

5. The materials A, B, and C herein specified shall contain sufficient moisture to insure maximum compaction.

VI. ADMIXTURES

6. Chemicals or other admixtures shall meet all the requirements of the current A.S.T.M. specifications. When the chemical to be used is not covered by A.S.T.M. specifications, a good commercial grade meeting the approval of the Engineer shall be used.

VII. METHODS OF TESTING

7. Sampling and testing shall be in accordance with the following standard methods of the A.S.T.M.: (a) sampling: D420 (b) size: D422 (c) liquid limit: D423 (d) plasticity index: D424

■

Part Three

BUSINESS PROCEEDINGS OF

AMERICAN PUBLIC WORKS ASSOCIATION

Meeting of Board of Directors

Chicago, Illinois *January 9, 1937*

THE Board of Directors of the American Public Works Association held their first meeting on Saturday, January 9, 1937 at the Palmer House in Chicago, Illinois. Thomas Buckley, President of the A.P.W.A. who presided, called the meeting to order at 10:15 A.M. J. Eugene Root, Guy Brown, Mark B. Owen, Lester Herzog, George Gascoigne, Paul Brockway, Roy Phillips, Henry Howe, William Galligan, Frank Herring, and Norman Hebden were present. Telegrams of regret were received from Frederick Paul and John Flockhart, who were unable to be present.

In opening the meeting, which was the first one of the new Association, President Buckley made a few introductory remarks in which he stressed the need of and asked for concentrated energy on the objectives of the American Public Works Association. He also expressed appreciation of the able Board of Directors which can assist him materially in his work.

A resolution was passed authorizing the President to extend an expression of thanks to Mr. Galligan and the Joint Administrative Board of the A.M.E. and I.A.P.W.O. for their loyal work in the past.

It was also resolved that an expression of sincere appreciation and thanks be extended to the Spelman Fund of New York for the cooperation and aid it has given to the A.M.E. and I.A.P.W.O. and the new Association.

A resolution was approved authorizing the President to express the pleasure of the Board for the commendable work of the Executive Director.

A motion was passed appointing Frank W. Herring to the post of Executive Director of the A.P.W.A. Approval was given to a motion that his compensation for the year 1937 be $6000.

President Buckley appointed Guy Brown and Paul Brockway as a committee of two to audit the books and the final report of the Treasurer of the American Society of Municipal Engineers. He likewise appointed Mark Owen and William Galligan to audit the books and final report of the Treasurer of the International Association of Public Works Officials. Both committees later reported

that they had made the audit of the respective books and reports and that they stand approved.

Guy Brown moved that Mark Owen and George Gascoigne be made members of the Executive Committee until the next election of officers. The motion was carried.

Establishment of Financial Procedures

A motion was carried giving the approval of the Board of Directors to the accounting and financial procedure established by the Treasurer of A.P.W.A., a draft of which was reviewed.

A resolution was presented which authorizes the Executive Director, Frank W. Herring, the Assistant Director, Norman Hebden, and the Treasurer of the A.P.W.A. to approve statements and sign checks in the conduct of the Association's business. The resolution was approved.

It was moved and passed that the Executive Director, the Assistant Director, and the Treasurer should be bonded, at the Association's expense, to the amount of $7500 each.

Opening Date for Convention Set

The consensus of the Board of Directors was that the annual conference should open on Monday, October 4, 1937, and it was so moved and approved. No decision was made as to whether the conference should continue three or four days. This matter is to be decided by the program committee.

President Buckley appointed a conference Program Committee consisting of the Executive Committee (which includes G. Gascoigne and M. Owen), Frank Herring, and Norman Hebden.

Schedule of Dues

A resolution was approved fixing the dues of the A.P.W.A. at $7.50 per annum and providing that all grades of membership shall, in the future, pay this rate. It was further resolved that there will be withheld from any member more than four months in arrears in dues, until his dues delinquency be paid up, all publications of the Association which a member receives free of charge or at lower cost than to a non-member.

Recognition of Existing Chapters

A resolution covering the recognition of existing chapters of the A.P.W.A. was adopted as amended to include refunds to chapters. (See copy of resolution in minute book.)

It was ordered that the President appoint a committee of three to draft a set of rules for governing chapters of the A.P.W.A. Mr. Buckley appointed Henry Howe, chairman, Guy Brown, and Frank Herring to this committee.

Incorporation of the Association

A motion was made and carried that the A.P.W.A. be incorporated under the statutes of the State of Illinois. Incorporation papers were signed by the officers of the Association who were present.

Membership Classification Procedure

Roy Phillips moved that all those who are now active members be continued as active members in the A.P.W.A. This motion was passed. It was agreed that the Executive Director should perform the reclassification of present members and that he should classify future applications for membership.

The Executive Director was instructed to write the Senior and Life members of the A.M.E. and I.A.P.W.O. advising them that they are eligible for Senior membership in the A.P.W.A. if they so elect. Honorary members of the I.A.P.W.O. are, in accordance with the A.P.W.A. constitution, continued as Honorary members of this Association.

1937 Budget

The Executive Director submitted the 1937 budget which was approved as drafted.

Research Budget

After a discussion of the proposed research budget for the years 1937 and 1938, which includes in its scope the manuals and the further revision of the standard specifications, a motion was passed that application be made to the Spelman Fund for funds to support the proposed budget.

Committee on Special Fund

President Buckley appointed a committee to study and make recommendations as to the handling and use of the Special Fund which the A.P.W.A. has for investment; the Veterans' Award medals shall have first call on these funds. The committee is composed of Henry L. Howe, chairman, H. P. Eddy, Jr., W. W. DeBerard, L. W. Herzog and W. J. Galligan.

Resolution to Support Meeting of International Union in the U. S.

A special resolution authorizing the Executive Director to sign a resolution of the American Committee of the International Union of Local Authorities urging that said Union hold its 1939 meeting in the United States was passed.

Organization of Divisions of A.P.W.A.

The Board moved that the membership be canvassed by letter ballot to permit the members to select the Division they wish to be affiliated with. President Buckley was directed to appoint a temporary chairman to head each division until the election of new chairman at the annual conference; said appointment to be made from the ranks of the Board of Directors.

Membership Promotion

Discussion was given to specific methods of membership promotion and to gaining and holding the interest of new members. The following suggestions were offered:

It is important to get the Association's literature before the Mayors and Managers (the public works man's boss).

Make use of testimonial letters. Roy Phillips will draft a letter to be sent to Mayors citing the advantages of and need for belonging to this Association. (Note: Hebden suggests getting several Mayors to write letters explaining the advantages of having the public works official belong.)

Stress and spread the idea of our personnel service; the help it gives the public works official in securing competent personnel and also its value in placing him.

A studied effort must be made at the convention to get people acquainted; utilize a reception committee to introduce new men. President Buckley will appoint such a committee. (The committee appointed includes: Mark Owen, Chairman; Alfred E. Roche, C. W. S. Sammelman, William J. Galligan, Roy Phillips, and Samuel S. Baxter.)

Get new members into a committee meeting at the convention or appoint them to some committee there to make them feel at home. It helps a new member and also the Association when he can show his Mayor that he took an active part.

It was stressed that the Board of Directors should keep in mind

the value of having the public works official of small cities as chairman of the Divisions, since the Association can be of greatest benefit to the men of the smaller communities.

It was resolved that one of the primary objectives of this Association in 1937 shall be an extensive campaign to increase the membership.

Specification Procedure

A discussion of the proposed procedure for drafting new and revised specifications, including that of the various specification committees, brought out the suggestion that said procedure should emphasize the desirability of having committee meetings. The committees should get together at least once each year.

The Board passed a motion to approve the specification precedure as amended. (See minute book for copy.)

Roy Phillips was appointed by President Buckley to represent the A.P.W.A. on the A.S.A. sectional committee on Brick Masonry.

It was moved that the solicitation for memberships in the A.S.A. be filed for the year 1937.

The meeting was adjourned at 5:00 P.M.

Meeting of Executive Committee

Atlanta, Georgia *April 4, 1937*

THE Executive Committee of the American Public Works Association met on Sunday, April 4, 1937 at the Atlanta Biltmore Hotel in Atlanta, Georgia. Thomas Buckley, President of A.P.W.A., who presided, called the meeting to order at 9:45 A.M. Those present were: J. E. Root, Guy Brown, J. S. Flockhart, G. B. Gascoigne, F. W. Herring, and N. Hebden.

The minutes of the meeting of the Board of Directors of A.P.W.A. which was held in Chicago on January 9, 1937 were read. There were no additions or corrections made and the minutes stood approved as read.

Auditor's Report, 1936

The report of the auditor covering the Association's financial operations for the period January 1, 1936 to December 31, 1936 was

presented by the Executive Director. The report was read and discussed, following which the Executive Committee accepted it with their approval.

Committee on Special Fund

J. S. Flockhart, Treasurer of A.P.W.A., who has custody of the Special Fund (made up of the surplus funds of the former A.M.E. and I.A.P.W.O.) submitted a report on the cash position of this fund. He reported that the portion of the Special Fund which is invested in U. S. Government Bonds and stock is still in the hands of Roy Phillips who is having them transferred. The report was approved and accepted by the Executive Committee.

Discussion was given to the Veterans' Award Medals and it was called to the attention of the Committee that the resolution establishing the Special Fund stated that the medals would have first call upon this fund. President Buckley instructed the Executive Director to discuss with Mr. S. Greeley whether or not he wishes that the medals continue to be awarded by the American Public Works Association.

1937 Public Works Congress

Duration. The Executive Committee, after due consideration, decided that the 1937 Public Works Congress should convene for three days, opening on Monday, October 4 and closing Wednesday, October 6.

Program. Consideration was given to the various business sessions, the meetings of the Divisions, and so forth which must be coordinated, and a tentative outline of the convention program was agreed upon by the Executive Committee. The points agreed upon by the Committee included: that the meetings of the three Divisions (Administration, Design and Construction, and Operation and Maintenance) should not be held simultaneously; that a meeting of the Board of Directors be held on Sunday, October 3, 1937, and also, that the newly elected Board of Directors meet on the last day of the conference; and that the banquet be held on Tuesday night, October 5.

It was the consensus of the Executive Committee that, in correlating the convention proceedings with the 1938 Yearbook, the standing committees of the Association should submit progress reports. Particular emphasis should be placed on getting reports from those

committees in which the information covering their field of activity is not up to date. Also, it was decided to include two panel discussions in the program, one on administration and one on maintenance and operation.

The program provides for seven papers and the following topics were agreed upon as satisfactory:

1. A street paving subject.
2. Atlanta's program of sewage treatment.
3. The sale of steam generated at Atlanta's incinerator.
4. Administering municipal services during a great flood—Cincinnati.
5. Birmingham's new industrial water supply (to include such information as steel *vs.* cast iron pipe and why separate from regular municipal system).

Subjects for papers 6 and 7 were not selected and a motion was passed that these subjects be selected by the President and the Executive Director acting for the Program Committee.

Exhibits. A lengthy discussion was given to the question of commercial exhibits and because of the lack of suitable exhibit space in Atlanta hotels, it was agreed not to hold any exhibits at the 1937 congress.

The Executive Committee decided to charge a registration fee to replace the net loss in revenue attributable to not holding the exhibits. The amount of this registration fee to be determined later as it is dependent upon the contribution the City of Atlanta will make.

The Executive Director was instructed to write past exhibitors explaining that suitable facilities are not available at the hotel for holding exhibits and as a consequence they will be dropped this year. The letter to be so worded as to leave the way open for next year.

Entertainment. A general program of entertainment was discussed and the ideas of the Local Arrangements Committee were expressed by Mr. Cates, chairman. It was agreed that the matter of entertainment should be worked out by him.

1938 Yearbook

The Executive Director submitted an outline for the contents of the 1938 Yearbook which had been worked out in conjunction with

President Buckley. A new conception is introduced in that articles are to be included in addition to the material presented at the 1937 Public Works Congress. The Executive Committee gave its approval to this idea and to the proposed outline, as follows:

I. Public Works in 1937
   A review of events and developments
   - A. Public Works Administration
   - B. Public Works Financing
   - C. Public Works Engineering
     Reports of Standing Committees

II. Current Problems in Public Works
   Papers presented at the 1937 Congress

Special Grant from Spelman Fund

The Executive Director informed the Committee that the request of the Association for a grant for special research had been approved by the Spelman Fund. This special fund to the amount of $17,000 is to cover the definite program of research as submitted. The Executive Director explained that he is now interviewing qualified persons in the effort to secure a man to carry on this research program.

Regulation Governing Chapters

A set of regulations governing the establishment and conduct of chapters of the American Public Works Association as drafted by a special committee appointed by the President (H. Howe, Chairman, G. Brown, and F. W. Herring) were submitted for approval by the Executive Committee.

There was only one point on which there was not complete agreement; this concerned the chapter funds reverting to the parent Association in case of the dissolution of a chapter. The Executive Committee passed a motion to strike out this clause. The regulations as thus corrected were approved.

Other Business

A letter was read from C. Upham, Executive Director of the American Road Builders Association, suggesting that the A.P.W.A. hold its annual conference in conjunction with the Road Show. The Committee instructed the Executive Director to write Mr.

Upham thanking him for the suggestion but to explain that it would be impractical to carry this out, at least for the next few years.

A letter from W. W. Horner, who represents the A.P.W.A. on the Highway Research Board, was also read. The Highway Research Board informed him that it was seeking contributions from member organizations. The Executive Committee passed a motion to the effect that a contribution from the A.P.W.A. would not be granted and to so inform Mr. Horner.

The Associated General Contractors of America, through its national headquarters, requested that our membership support an amendment to the Federal Revenue Act of 1936 relative to waiving the undistributed profits tax if such surplus earnings were invested in construction, etc. The Executive Committee voted to file the request. The Executive Director advised the Contractors' Association that our organization refrains from influencing national legislation.

The meeting adjourned at 4:35 P.M.

Meeting of Board of Directors

Atlanta, Georgia *October 3, 1937*

A DINNER meeting of the Board of Directors of the American Public Works Association was held on Sunday, October 3, 1937, at 7:00 P.M. in the Atlanta Biltmore Hotel, Atlanta, Ga. Thomas Buckley, President of the Association, presided. Those present included: L. W. Herzog, W. J. Galligan, J. E. Root, J. S. Flockhart, E. S. Rankin, P. L. Brockway, R. L. Phillips, G. Brown, H. J. Cates, C. W. S. Sammelman, F. T. Paul, F. W. Herring, and N. Hebden.

The minutes of the last Executive Committee meeting, held in Atlanta on April 4, 1937, were read. They were approved as read.

The Executive Director presented his annual report for the membership year covering the period from September 1, 1936, to August 31, 1937. A discussion of membership promotion activities undertaken during the year followed the report. A motion was passed commending the Executive Director for his work and approving the annual report.

H. J. Cates, Local Arrangements Chairman, reported splendid cooperation on part of Atlanta people in preparing for the convention. He reported also on efforts toward the establishment of a southeastern chapter. It was his opinion that enough people in this territory have expressed interest in the formation of a chapter to assure its organization. Mr. Buckley congratulated Mr. Cates and expressed his thanks for achievements of the Local Arrangements Committee under his guidance.

The chairmen of the Association's Divisions decided to appoint Nominating Committees to select candidates for the chairmanships of the divisions for the next year, these committees to be appointed by 11:00 A.M. Monday, October 4, 1937.

The Treasurer of the Association, J. S. Flockhart, submitted his annual report for the past year. A motion was passed to approve and file the Treasurer's report.

President Buckley announced the appointment of the nominating committee to select candidates for Association offices for the next year. The Committee was as follows: P. L. Brockway, Chairman, A. M. Anderson, H. D. Bradley, E. S. Rankin, and F. T. Thorpe, Jr.

The Executive Director submitted the annual reports of the following chapters: Chicago, Rochester, New Orleans, Philadelphia, Michigan, and St. Louis. A motion was passed that these reports be received and filed.

The resolution submitted by the Chicago chapter concerning a national department of public works was read. Following the discussion of this resolution it was moved to refer the matter to the Committee on Resolutions. The motion was passed.

The meeting adjourned at 10:15 P.M.

Report of Executive Director

THIS report covers the period September 1, 1936 to August 31, 1937, and therefore includes four months of operation of the Joint Secretariat of the American Society of Municipal Engineers and the International Association of Public Works Officials, and eight months of operation of the American Public Works Association. However, as our financial records are maintained on the basis of the calendar year, and the financial report for the calendar year

1936 has already been submitted, the financial statement accompanying this report covers only the first eight months of 1937.

FORMATION OF THE AMERICAN PUBLIC WORKS ASSOCIATION

At the meeting of the Board of Directors of the American Society of Municipal Engineers and the Board of Governors of the International Association of Public Works Officials held at Toronto, September 27, 1936, action was taken leading toward the formal union of those two organizations and establishment of the American Public Works Association. The approval of these two governing bodies was given to a proposed constitution for the new organization and the Executive Director was instructed to submit that constitution to the membership of both organizations for letter ballot. Those ballots were sent out from the headquarters' office on October 20, and the returns were canvassed by the Joint Administrative Board at a meeting held in Chicago on November 21, 1936. The canvass disclosed the following vote: members of the American Society of Municipal Engineers, 278 in approval, 11 in disapproval; members of the International Association of Public Works Officials, 203 in approval, 4 in disapproval.

A joint nominating committee designated by the two associations at the Toronto convention nominated the following persons as officers of the new association: Thomas Buckley, president; J. E. Root, first vice-president; Guy Brown, second vice-president; and John Flockhart, treasurer. A ballot sent to the membership on November 24 elected these men to the offices named.

By action of the governing boards of the two societies, their surplus funds were turned over to the newly elected Treasurer of the American Public Works Association on January 1, to be used for such special purposes as may be recommended from time to time by a Special Fund Committee and approved by the Executive Committee of that association. It was further provided that the continuance of the Veteran's Award should have first call on the fund.

The action of the governing boards at the Toronto meeting designated January 1, 1937, as the effective date of the new constitution.

At the first meeting of the Board of Directors of the American Public Works Association held in Chicago, January 1937, the Executive Director was instructed to apply to the Secretary of State

of Illinois for incorporation of the association. This application was duly made and incorporation papers were received in March.

Spelman Fund Grant

At a meeting of the Joint Administrative Board held in Chicago on November 21, 1936, approval was given to a proposal to apply to the Spelman Fund of New York for a new grant to assist in the financing of our operations during 1937 and 1938. The application was forwarded to the Spelman Fund shortly thereafter and on December 18, 1936, the Executive Director was notified that a grant of $39,000, or so much thereof as may be necessary, had been appropriated for that purpose.

Current Membership Status

On August 31, 1937, the total enrolled membership of the Association was 812, which included 669 members fully paid up in dues and 143 members in arrears. Fifty-six of these delinquent members, who were in arrears for two years, were removed from the rolls on September 1, in accordance with the provisions of Article IX of the constitution. Two more members were removed from the rolls at that time because of having submitted resignations to be effective on that date.

The membership figure of 812 is to be compared to a figure of 784 on the same date last year, a net increase of 28. There were 114 new members elected, 32 resignations accepted, 7 deaths reported and 49 members dropped for non-payment of dues. The paid-up membership shows a greater increase—from 628 in 1936 to 669 in 1937, an increase of 41. The changes in membership during the year are shown in the following table.

Report of Changes in Membership

September 1, 1936 to August 31, 1937

Total Membership September 1, 1936	784
Resignations	—32
Deaths	—7
Dropped for non-payment of dues	—49
New Members	+114
Reinstatements	-
Net gain	28
Total Membership September 1, 1937	812
Applications pending	1

ANALYSIS OF PAID-UP MEMBERSHIP

September 1, 1937

Paid to:	
September 1, 1938	20
March 1, 1938	68
September 1, 1937	551
Senior, Life, and Honorary	30
TOTAL	669

ANALYSIS OF DELINQUENT MEMBERSHIP

September 1, 1937

Paid to:	
March 1, 1937	7
September 1, 1936	78
March 1, 1936	2
September 1, 1935	56
TOTAL	143

An analysis of the 812 members reveals the following classifications:

CLASSIFICATION OF MEMBERSHIP

City Engineers, Directors of Public Works, Other Municipal Officials having equivalent degrees of responsibility	179
Assistant City Engineers, Bureau Heads, Other Municipal Officials	269
County, State, Federal, and Special District Officials	57
Consulting Engineers	88
Professors, Editors, Public Utility Engineers and Others	126
Commercial	93
TOTAL	812

The 179 ranking public works officers in the Association represent 150 American cities. As there are 3,166 urban communities in the United States, this represents a coverage of but 5 per cent. However, a study of American cities reveals the fact that 2,183 of these "urban communities" have populations of less than 10,000. It is my belief that communities smaller than 10,000 will be extremely difficult for us to include within the membership of our Association because of the low level of compensation of engineers in such towns, the great number of communities in which there is no appropriate official to include in our membership, the undistinguished caliber of the officials in many others, and other reasons.

An analysis of the number of cities represented by ranking officials in the membership of the Association, on the basis of population groups is shown in the following table:

U. S. CITIES REPRESENTED IN MEMBERSHIP

Population Group	Number of Cities in Group	In A.P.W.A. By Ranking Public Works Official	Cumulative Number of Cities	Cumulative Number of Cities in A.P.W.A.	Cumulative Per Cent
500,000 and Over	13	9	13	9	69
300,000 to 500,000	12	7	25	16	64
200,000 to 300,000	16	7	41	23	56
150,000 to 200,000	11	5	52	28	54
100,000 to 150,000	41	10	93	38	41
75,000 to 100,000	26	12	119	50	42
50,000 to 75,000	69	20	188	70	37
25,000 to 50,000	189	29	377	99	26
10,000 to 25,000	606	34	983	133	14
2,500 to 10,000	2183	17	3166	150	5

It will be seen that the Association has within its membership the ranking official from more than 40 per cent of the communities of 75,000 population and over. Representation begins to fall off as we reach the next population group, 50,000 to 75,000, and falls rapidly below 50,000. The figure of 5 per cent cited in a foregoing paragraph may be accounted for by the meagerness of our representation in the smallest population group and the large number of cities in that group.

MEMBERSHIP PROMOTION EFFORTS

During the year more than 14,000 pieces of promotional literature designed to increase membership have been sent out from the headquarters' office. These efforts have included a large number of individually written letters addressed to prospective members, form letters addressed to large groups of prospects, letters addressed to mayors and city managers, specially prepared printed material discussing the Association's activities and sent to prospects and mayors, and letters addressed to the existing membership requesting their aid in our membership promotion efforts.

The last item mentioned accounts for 1,600 letters addressed to our existing membership. These letters yielded the names of 50 prospects, each one of which was urgently solicited for membership by the

headquarters' staff. The number of applications received during the year which can be directly traced to this membership aid is 9. In addition, the new Rochester chapter, formation of which can be attributed almost wholly to the efforts of our existing membership in that city, accounts for 38 new members.

In addition to membership promotion by mail, the Executive Director has met frequently with groups of City Engineers and Public Works Directors in the various states and has endeavored to interest them in membership.

Although this membership promotion effort appears to be relatively ineffective in increasing our enrollment, it is my sincere belief that the growing familiarity of public works people the country over with the activities of our Association will serve to make our membership extension work less difficult in the years to come. I feel that the fundamental spade work has largely been done and that a continuing program of activity resulting in real accomplishment will be the most effective means of achieving a larger membership.

Financial Status

There is included in this report a statement of the receipts and disbursements of the Association for the eight months ending August 31. This statement includes the budget figures established by the Board of Directors at its meeting in Chicago in January 1937. Careful study of this statement indicates that the expenditures for the remaining months of the calendar year will be within the estimated revenues.

Chapter Organization Activities

I am pleased to submit reports from the secretaries of the Chicago, Philadelphia, New Orleans, Rochester, and Michigan chapters of our Association. A reading of these reports indicates that our chapters are increasing in vitality and are serving their membership well by providing opportunities for contact during the intervals between national conventions of the Association.

Efforts are now under way looking toward the establishment of a southeastern chapter of the Association, to include the states of Georgia, Alabama, Florida, North Carolina, and South Carolina. It is believed that a petition for the formation of such a chapter will be submitted to the Board of Directors at its meeting on Oc-

tober 6. Mr. H. J. Cates of Atlanta has been the prime mover in this effort.

The Executive Director has recently had conversations with the officers of public works groups of the League of Wisconsin Municipalities regarding the possible establishment of a chapter of the Association in that state.

Research Program

At the meeting of the Board of Directors held in Chicago in January, it was decided to apply to the Spelman Fund of New York for a supplemental grant of funds to enable the Association to engage in a program of special study in the field of public works administration. A tentative program was drawn up and submitted to the Spelman Fund in connection with the application for such a grant. The application was approved and a grant of $17,000 for the conduct of that program was made available in March 1937, to run for two years from that date.

On May 1, Mr. Stanley Pinel, Engineer of the Louisville Bureau of Governmental Research, joined the staff to undertake the staff work in connection with that program. Mr. Pinel has had wide experience in the municipal public works field, having been on the engineering staffs of two cities, two consulting engineers, a state university and the afore-mentioned governmental research bureau. He directed his attention immediately to completion of the manual on "Street Cleaning Practice" and the progress on that manual will be the subject of a report presented before the convention Wednesday morning.

On July 15, Mr. Carl Schneider was engaged as special consultant on the manual of "Refuse Collection and Disposal Practice." Mr. Schneider chose to conduct his operations with New Orleans as his headquarters. He continued his efforts at completing his contribution to the manual until September 20, when he was engaged by the city of Montclair, New Jersey, to assist in the installation of a refuse collection system. Progress being made on this manual will also be the subject of a report to be presented to the convention Wednesday morning.

Special Publications

The Association's activity in publishing has been increased considerably during the year. The first material to be given special

publication were three special bulletins, which were in effect reprints of papers presented at the 1936 convention. The papers chosen for such publication were: "Stabilizing Earth Streets and Roads," by H. F. Clemmer; "The Management of a Sewage Treatment Plant," by F. W. Jones; and "Grinding as a Process in Garbage Disposal," by Mark B. Owen. Later special bulletins embodying the results of inquiries carried out by the headquarters' staff, on "Experience of Cities with Painted Traffic Lines on Brick Pavements" and "Financing Street Railway Track Removal and Repaving" were given publication. In the early summer a revised edition of the standard specifications of the Association were given publication in loose-leaf format. The staff is now assembling standard design details from a large number of cities and hopes to begin their publication before the end of the year.

Inquiries

The number of inquiries on public works practice received by the headquarters office is increasing steadily. The number of inquiries handled during the current year was more than 75. Many of these inquiries involve extensive searches in the library and examinations of municipal reports. It is interesting to note that the two most frequent subjects of inquiry have been refuse collection and sewer rental law administration.

Yearbook

The 1937 Yearbook was given publication in April. Unfortunately the book as distributed by the printer was considered unsatisfactory by reason of displaced type pages and inadequate margins, and the printer proposed that he be allowed to reprint the entire job and to distribute it to our membership at no expense to the Association. Permission was given him to do this and consequently each member of the Association received the second, better printed, copy of the publication.

News Letter

Publication of the News Letter has continued during the year. It is receiving considerable favorable attention from those in the public works field, both within and without our membership. The major function of this publication is to serve as a cementing agency for the membership rather than to be a technical journal. Accordingly a large share of its space is devoted to reporting developments

within the organization. The material in it having to do with public works practice emphasizes the administrative rather than the technical aspects of the field.

Miscellaneous Activities

In addition to the distribution of material published by the Association, there were made available to the membership during the year two other pamphlets published by outside agencies: the National Resources Committee's report on "Public Works Planning" and a report on "A Career Service in Local Government" published by the International City Managers' Association.

In December the Association participated in the conducting of an Institute of Government at Tuscaloosa, Alabama, a short school on public administration set up by the University of Alabama. Mr. Hebden of the headquarters' staff delivered a lecture on the elements of public works administration.

Through the participation of Mr. Burton Marsh, Chairman of the Committee on Traffic Control, the Association cooperated with Harvard University in conducting a Traffic Institute. Also, Mr. Marsh's committee has been made a joint committee with a committee of the Institute of Traffic Engineers.

A new specification committee, on stabilized roads, was established during the year, under the chairmanship of Mr. H. F. Clemmer, of Washington, D. C.

New Building

The new building being constructed to house the offices of the Association and those other organizations with whom it cooperates, now located at 850 East 58th Street, is about half finished. Although the original plan was that the building would be available for occupancy by the first of the year, my estimate is that its completion cannot be expected before March 1, 1938.

Annual Reports of Chapters

CHICAGO CHAPTER

The following is the annual report of the Chicago Chapter, as of August 31, 1937, submitted by the Secretary-Treasurer.

FINANCIAL STATUS

On deposit at The Northern Trust Company	$273.35	
On deposit at Wilmette State Bank	71.50	
Petty cash fund	30.50	
Cash on hand		$375.35
Received from preceding Secretary-Treasurer	$280.63	
Received from National Society (Dues)	135.00	
Interest—The Northern Trust Company	4.22	
	419.85	
Less expenditures	44.50	
		$375.35

Since the time of taking office on April 3, 1936, which is the date of the report of the preceding Secretary-Treasurer, I have received from the national society the amount of $135.00.

Our bank account at The Northern Trust Company has earned $4.22, interest to July 1, 1937.

Total expenditures for the period April 3, 1936, to August 1, 1937, are $44.50, which represents the cost to the Chapter of meeting deficits of several meetings and cost of mailing service.

There have been no dues collected directly from members of the Chicago Chapter. All dues received were in the form of rebates from the national society in accordance with the Constitution.

ACTIVITIES

Dinner meetings of the Chapter were held as follows: October 16, 1936, (Chicago), November 17, 1936, (Chicago), February 5, 1937, (Chicago), March 24, 1937, (LaGrange), April 23, 1937, (Waukegan), and May 28, 1937, (Chicago).

At the May 28, 1937, meeting the officers to serve from July 1, 1937, were elected as follows:

ROBERT L. ANDERSON	President
PAUL HANSEN	1st Vice-President
H. B. BLECK	2nd Vice-President
HAROLD VAGTBORG	Secretary-Treasurer

At the present time there are sixty-four members in the Chicago area.

MICHIGAN CHAPTER

In this the first annual report of the Michigan Chapter it might be well to trace briefly the developments which led up to the formation of the Michigan Chapter.

The Michigan Municipal League has sponsored a functional group of public works officials and has conducted round-table discussions at its annual meeting for several years. The group became particularly active in the summer of 1934 when it became known that constitutional amendments were to be submitted that fall which would curtail the revenues derived from gasoline and weight taxes from motor vehicles. This rather loosely organized group did an admirable job of collecting and distributing information pertinent to the above subject and widened its scope of discussions as time went on.

On March 27, 1936, Mr. Frank Herring, Executive Director of the Joint Secretariat, A.M.E.-I.A.P.W.O., appeared before the executive committee and discussed the matter of affiliation as a Michigan Chapter of the national organization. A dinner meeting was held at the Olds Hotel, Lansing, on May 26, 1936, at which twenty-four members and friends of the organization were present and a committee of five were appointed to revise a tentative set of rules and regulations which had been formulated and given authority to request the joint board to establish a Michigan Chapter.

After a meeting of this committee on June 25 and a considerable amount of correspondence, the committee, in behalf of the proposed Michigan section, sent a petition along with tentative by-laws to the joint board and their application was approved on September 27, 1936.

Activities

Information has been sent at various times during the year to the membership and especially to the executive committee on matters which have confronted the Michigan Chapter in that period. The secretary's records show that 145 letters were mailed out.

On November 27 a questionnaire was circulated to the membership requesting certain information on the problems of garbage grinding and the installation of air-conditioning equipment, particularly where cooling water was derived from ground water supplies and then dumped into the sewers. Responses came in from

fifteen of the members, all of them indicating that although they recognized these to be important and of current interest, their municipality had done nothing about the problem.

Upon the receipt of a letter from the executive secretary informing the membership of the change in name of the organization, the executive committee met on January 15 in Ann Arbor to revise the Chapter by-laws to conform with the revision of the name of the parent organization. The membership was canvassed, 21 votes being cast for the proposed amendment and none against it. A meeting was sponsored by the Michigan Chapter in Lansing on February 18. The attendance of eleven was disappointingly small.

Membership and Finances

The total membership in the year was 33, including 23 renewal memberships and 10 new ones.

Refunds were made to the Michigan Chapter in the total amount of $90.00. This covers a little more than the established fiscal year and on the basis of the present membership, the refunds for the next fiscal year will be slightly less.

In a letter to the Executive Director dated December 9, 1936, the secretary-treasurer requested that the refunds on membership be deposited with the other funds of the Michigan Municipal League and that they would be used for secretarial and other services on the part of this organization. This procedure has been adopted and the cost of stenography, mimeographing, postage, etc., has been absorbed by the League. The actual expenditures for materials and supplies, as nearly as it can be estimated, has been $18.76. The period, however, does not include the annual convention at which time it was agreed that stenographic notes would be kept of all discussions and the information distributed to the membership. This item will, of course, appear on the report for the succeeding year.

Officers

At a meeting held on Thursday, September 16, the following officers were elected during 1937-1938:

C. R. Wightman, Benton Harbor	President
J. H. Moorhouse, Highland Park	Vice-President
H. A. Olson, Ann Arbor	Secretary-Treasurer
W. J. Wallace, Detroit	Executive Committeeman
G. H. Sandenburgh, Ann Arbor	Executive Committeeman

NEW ORLEANS CHAPTER

THE FOLLOWING report covers the activities of the New Orleans Chapter for the fiscal year 1936-37:

Four regular meetings, including this meeting, and two meetings of the Executive Committee, were held. These were as follows:

October 1, 1936. Executive Committee meeting convened for the purpose of appointing committees and planning Chapter activities for the year.

January 14, 1937. Executive Committee meeting to consider and arrange for the change of name of our Chapter from that of American Society of Municipal Engineers, to American Public Works Association, and to formulate plans for changing the by-laws of the Chapter to conform to the new constitution of the American Public Works Association.

January 22, 1937. Regular meeting held jointly with Louisiana Engineering Society.

April 9, 1937. Regular meeting at which Hampton Reynolds, Chairman of Planning and Development Board of New Orleans, spoke on the subject of P.W.A. Improvements in New Orleans.

May 20, 1937. Regular meeting at which D. G. W. Ricketts, State Project Supervisor of Louisiana Geodetic Survey, spoke on the subject of Precise Leveling and Traverse in the State of Louisiana.

We began the year with 32 members, consisting of 1 Senior member, 26 Regular members, and 5 Associate members. During the year 2 Regular members were elected, 1 was transferred, 2 were dropped, and 1 resigned. One Associate member was dropped. The membership on the rolls at the present time consists of 1 Senior member, 24 Regular members, and 4 Associate members, totaling 29.

STATEMENT OF FINANCES

On Hand—June 23, 1936	$140.81
Receipts (dues)	82.50
Total	$223.31
Disbursements	37.01
Balance on hand June 24, 1937	$186.30
Refund due Chapter from parent society on dues of D. W. Godat	2.50
Total	$188.80
Owed chapter by delinquent members	16.00
Total	$204.80

Six members are in arrears. Dues owed the Chapter by these delinquent members amount to $16.00.

In an effort to increase the interest and attendance at meetings, several interesting papers have been presented to the Chapter by well-known local engineers, and refreshments have been served after the meetings. These meetings have been well attended not only by the membership but by many guests.

Our Membership Committee has been rather inactive. During the year we placed only 2 new members on the rolls, while we lost 5 members. It is evident that in order to remain in a healthy state we should make every effort possible to keep our membership growing. The field is here for us and with an active Membership Committee and a little effort we should be able to increase our membership at least fifty per cent the coming year.

PHILADELPHIA CHAPTER

The principal activity of the Philadelphia Chapter is the holding of monthly meetings on public works and other subjects of interest to members, and a report must deal mainly with these meetings. During the year, the Chapter held eight regular monthly meetings with an approximate average attendance of sixty. The schedule of meetings is as follows:

Speaker	Subject
Oct. 22, 1936: Arnold H. Vey, Traffic Engineer, State of New Jersey	*Highway Improvement Essential for Accident Reduction*
Arthur F. Loewe, Engineer, General Electric Company	*Modern Highway Lighting*
Walter W. Mathews, Director, Philadelphia Safety Council	*A Layman's View of Municipal Traffic Control*
Nov. 19, 1936: Fred Jasperson, Manager, Port Richmond Terminal, Reading Company	*The Delaware River and Improvement of Delaware River Port within Recent Years*
Dec. 17, 1936: Christmas Party. Harry A. Mackey, Former Mayor of Philadelphia	

Jan. 28, 1937: (*Suburban Government Night*)	
Peter C. Hess, Treasurer of Lower Merion Township	
Alec C. Williams, Director of Public Works, Haverford Township	
Geo. E. Hesselbacher, Township Engineer, Cheltenham Township	
Oliver L. King, Township Engineer, Abington Township	
Feb. 25, 1937: (*Housing Forum*)	
Bernard J. Newman, Director, Philadelphia Housing Association	*Housing Legislation*
Georgina Pope Yeatman, Director, Philadelphia Department of City Architecture	*Zoning in Relation to Housing*
Augustine A. Porreca, Philadelphia City Planning Commission	*Adequate Recreation Facilities under Housing Programs*
April 1, 1937: Annual Dinner	
April 22, 1937: Formal visit of Chapter to Franklin Institute	
May 26, 1937: Alan Corson, Engineer, Fairmount Park Commission	*Fairmount Park*
Election of Officers	

These meetings were aimed to provide instructive and interesting information on a variety of subjects and each meeting brought out considerable discussion by the members from the floor after the regular program of speakers. The Chapter is indebted to Frederick T. Thorpe, Jr., Chairman of the Meetings Committee, for the arrangement of these meetings.

The Chapter continued its recognition of achievement in public engineering by presenting its meritorious service medal at the Annual Dinner on April 1, 1937. The recipient was Martin J.

McLaughlin, Director of Public Works, City of Philadelphia.

The annual contest for junior engineers for the best paper on a municipal engineering subject was won by David T. Anderson, with his paper on *Unique Sewer Design and Construction*. The second prize was awarded to Ralph A. Haffner, for his paper, *Traffic Signal Timing Aids*. Cash prizes to these men were also awarded at the Annual Dinner.

The Board of Directors, which manages the affairs of the Chapter, held nine meetings, with an average attendance of fifteen. The members of the Board were particularly zealous in their attention to the affairs of the Chapter.

The number of members on the roll at the end of the year was 117, of whom 87 had paid 1936-37 dues to the national association.

The Treasurer of the Chapter on June 18, 1936, had a balance of $489.46; the balance on May 27, 1937, was $465.44. It is noted that of this amount, $355.35 is held in a "frozen" account in a bank, which was closed and has reopened. While this money is not available at this time, it is hoped that a large percentage of it will return to the Chapter.

During the year, the Chapter changed over from a local chapter of the American Society of Municipal Engineers to a chapter of the American Public Works Association, in line with the change in the national organization. This was effected locally by amending the by-laws of the local chapter, thus providing for a continuing organization. The new by-laws were approved by the Executive Committee of the American Public Works Association on March 4, 1937, and approved by a letter ballot of the local members on May 26, 1937.

At the May meeting, the following officers were elected to serve during the year 1937-38:

Frederick T. Thorpe, Jr.	President
Robert A. Mitchell	Third Vice-President
Joseph C. Gibbs	Secretary
Frank L. Thomas	Treasurer
George T. Shegog	Member of Executive Committee
Charles P. McDermott	Member of Executive Committee
Robert S. Lyons	Member of Executive Committee
Charles A. Bareuther	Member of Executive Committee

The President desires to call attention particularly to the sincere cooperation of all the members of the Chapter, and especially the members of the Executive Committee and the Chairmen of the various committees.

ROCHESTER CHAPTER

As a result of the promotional dinner held in Rochester, N. Y., June 2, 1936, the Rochester Chapter of the American Society of Municipal Engineers and the International Association of Public Works Officials was established, with a total of forty-four charter members, made up of thirty-eight new members and six former members.

The notice of the official approval of the formation of the Rochester Chapter by the official boards of the two societies was received on September 21, 1936.

During the past year, from July 1, 1936 to July 1, 1937, the Executive Committee of this Chapter held four meetings, as follows: August 26, 1936, February 4, 1937, March 8, 1937, and May 21, 1937.

In addition to the organization meeting, which was held after the promotional dinner on June 2, 1936, at which time Frank W. Herring, Executive Director, was in attendance, the Rochester Chapter held a meeting on March 31, 1937, at which the principal speaker was Harrison P. Eddy, Jr., Past President of the American Society of Municipal Engineers, who spoke on the subject, "The New Rochester Incinerator and Waste Heat Boiler Plant."

At the same meeting the Rochester Chapter adopted changes in the by-laws to provide for the change in name of the Chapter from the "Rochester Chapter of the American Society of Municipal Engineers and International Association of Public Works Officials," to "Rochester Chapter of the American Public Works Association."

The third and annual meeting of the Rochester Chapter was held May 27, 1937, and the following officers for the year 1937-38 were duly elected:

Morgan D. Hayes	President
John V. Lewis	First Vice-President
Meloy Smith	Second Vice-President
E. A. Miller	Member of Executive Committee
Kenneth J. Knapp	Member of Executive Committee
Henry L. Howe	Secretary-Treasurer

Following the election of officers, the Secretary-Treasurer gave the Treasurer's report for the Chapter, as shown in detail in the minutes of the annual meeting of the Chapter. On July 1, 1937, the Chapter had cash on hand in the Chapter treasury of four hundred and fifty-five dollars and thirty-seven cents ($455.37).

The retiring President, Thomas J. Morrison, then introduced the newly-elected President, Morgan D. Hayes, City Engineer of Rochester, who spoke on the subject, "Pioneering in the Water Works Field." The paper and talk was accompanied by lantern slides.

The membership of the Rochester Chapter on June 30, 1937, was forty-four members; no gains or losses during the fiscal year.

ST. LOUIS CHAPTER

At the dinner meeting of the St. Louis Chapter of the American Public Works Association on June 18, 1937, the following chapter officers were elected:

John B. Clayton, Jr.	President
E. H. Paffrath	First Vice-President
E. C. Renard	Second Vice-President
Francis Kernan	Secretary-Treasurer
Erwin E. Bloss	Director
W. A. Heimbuecher	Director

It was reported that the revised Chapter by-laws had been passed by vote of the Chapter by letter ballot. Meetings were planned for the coming year and the type of meeting favored is to have a suburban city act as host, meeting there in the latter part of the afternoon to inspect the city, and having dinner about 6:30 P.M. to be followed by the business meeting.

The Secretary-Treasurer reported a balance of $242.14 of which $28.77 is still held in a closed bank.

Meetings of the Association Divisions

October 4, 1937

THE THREE Divisions of the Association—the Administration Division, the Design and Construction Division, and the Maintenance and Operation Division—each met on Monday morning, October 4, at the annual convention, and elected a chairman for the ensuing year. (The chairman of each Division is also a member of the Board of Directors.) J. E. Root, Guy Brown, and W. J. Galligan served as acting chairmen of the Divisions, respectively, and conducted these meetings.

Mr. Root (presiding) called for the report of the Nominating Committee for the Administration Division. The nominee was L. G. Lenhardt, Commissioner of Public Works, Detroit. It was moved, seconded, and carried that the nominations be closed and a unanimous ballot cast for Mr. Lenhardt. Mr. Root so cast the unanimous vote.

President Buckley, at this point, named the Nominating Committee for the selection of Association Officers and Directors comprising P. L. Brockway, chairman, E. S. Rankin, F. T. Thorpe, A. M. Anderson, and H. D. Bradley. He also named the following to the Resolutions Committee: W. E. Rosengarten, chairman; J. S. Flockhart; and F. W. Herring.

Mr. Brown then took the chair, and the Nominating Committee for the Design and Construction Division reported the selection of F. T. Paul, city engineer, Minneapolis, as chairman. A motion that Mr. Paul be unanimously elected was put to a vote and carried.

Mr. Galligan was then requested to preside at the meeting of the Maintenance and Operation Division. H. D. Bradley, street commissioner, Toronto, was nominated for the chairmanship of this Division and a unanimous vote was cast for his election to this post.

As there was no other business, the meeting adjourned.

Business Meeting of the American Public Works Association

October 5, 1937

THE ANNUAL business meeting of the American Public Works Association was held in Atlanta, on Tuesday, October 5, 1937. Thomas Buckley, President of the Association, presided.

The Nominating Committee reported its nominations for the officers of the Association and the Board of Directors as follows: J. E. Root, *President;* Guy Brown, *First Vice-President;* John S. Flockhart, *Second Vice-President;* and Roy L. Phillips, *Treasurer;* L. W. Herzog, *Director* (one year); W. E. Rosengarten, *Director* (two years); Henry L. Howe, *Director* (three years); and W. J. Galligan, *Director* (four years). Mr. Heimbuecher moved that the nominations be closed and that a unanimous ballot for the nominees be cast. The motion was unanimously carried.

President Buckley read the names of the newly elected chairmen of the Association's Divisions who also are members of the Board of Directors. They were: L. G. Lenhardt, F. T. Paul, and W. J. Galligan.

President-Elect Root was then presented to the delegates at the Congress by Mr. Buckley.

The executive director was called upon, and he read his annual report. (See page 360 for the text of this report).

It was moved, seconded, and carried that the reports of the chapters and the committee reports be accepted and placed on file awaiting publication in the Yearbook.

The following motion was submitted by Mr. Galligan: that H. P. Eddy, Jr., A. E. Roche, R. B. Brooks, and W. J. Galligan, together with any other members of our organization who can possibly attend the International Cleansing Conference to be held in Budapest in August 1938, be designated as the official representatives of this organization, with the understanding, of course, that this Association is under no financial obligation. The motion was put to a vote and carried.

President Buckley addressed the delegates and expressed his appreciation and sincere thanks for the cooperation of the Member-

ship, the Board of Directors, and the Staff during his term of office. His remarks were greeted with sustained applause.

The Necrology Report was presented by the executive director as follows:

During the period from October 1, 1936, to September 1, 1937, the deaths of eight members of the Association have been reported. The deceased members are as follows: Harrison P. Eddy; John H. Gregory; Thomas J. Hiler; Walter C. Dodd; Nicholas S. Hill, Jr.; Percy E. Hunter; Clarence D. Pollock; and James V. Monahan.

In respect to the deceased members, President Buckley had the group rise and stand in silence for one moment.

The meeting adjourned at 12:40 P.M.

Necrology Report

Harrison P. Eddy, member of the Association since 1914, passed away June 15, 1937 in Montreal, Canada at the age of 67. At the time of his death, he had gone to Montreal to receive honorary membership in the Engineering Institute of Canada. Mr. Eddy graduated from the Worcester Polytechnic Institute in 1891 and he began his career in public service as superintendent of the sewage treatment plant at Worcester in 1892. In 1907, he formed a partnership with Leonard Metcalf, and he continued as an active member of the consulting firm of Metcalf and Eddy until the time of his death. He served as a member of many advisory boards, including the Engineering Board of Review, for the Chicago Sanitary District, and the P.W.A. board of review. He was the author of many important technical articles, and his textbooks on sewerage practice, of which Metcalf was co-author, were considered the "standard" treatise on this subject. In 1930, Worcester Polytechnic Institute honored Mr. Eddy by awarding him the degree of Doctor of Science.

Nicholas S. Hill, Jr., age 67, died on October 18, 1936 at his home at Green's Farms, Connecticut. He was a consulting engineer in New York City and also president of the Hackensack Water Company, at the time of his death. He was graduated from the Stevens Institute of Technology and his wide and varied experience included: mechanical engineer, South Side Elevated Railway, Chicago; engineer, Baltimore Sewerage Commission; Chief En-

gineer, Baltimore Water Department; Chief Engineer, Department of Water Supply, Gas and Electricity, New York City; and consulting engineer on water supplies, sewerage systems, and public utility valuation. Mr. Hill joined the Association in 1911.

THOMAS J. HILER, who had been a member of A.P.W.A. since 1928, died in New York City on October 18, 1936. Since 1920, Mr. Hiler had been vice-president of the Hiler Engineering and Construction Company and was engaged in sewer contracting and the manufacturing of incinerators. Prior to that time he had been with the Brooklyn Ash Removal Company, and the Boston Development Company.

COL. WALTER C. DODD died in London, Ontario, on December 17, 1936. At the time of his death, he was city superintendent of London. Col. Dodd joined the Association in 1928.

JOHN H. GREGORY, age 63, died very suddenly on January 18, 1937 in Baltimore, Md. He received his education at Massachusetts Institute of Technology and entered public service with the Boston Metropolitan Sewerage Works in 1893. Later, he successively served in the water works of Boston, Albany, Philadelphia, Jersey City, New York, and Columbus; and he also was identified with the Columbus Sewerage Works, the Passaic Valley Sewerage Project and the Metropolitan Sewerage Commission, New York. In 1911, he formed a partnership with Rudolph Hering in New York. In 1917 this partnership was dissolved and he continued as a consultant on municipal sewerage and water works until the time of his death. The cities of Baltimore and Columbus retained him as consultant during this period.

In 1920, Mr. Gregory was appointed professor of Civil and Sanitary Engineering at Johns Hopkins University. He was the recipient of numerous engineering awards and the author of many technical articles. He had been a member of A.P.W.A. since 1921.

PERCY E. HUNTER died on May 25, 1937, in Pittsburgh, Pennsylvania, at the age of 64. He graduated from the Western University of Pennsylvania (now the University of Pittsburgh) and his first

position was on the engineering staff of the city of Pittsburgh. Later, going into private industry, Mr. Hunter invented a steel safety railing. At his death, he was president of Hunter Steel Company, the Ohio Valley Steel Company, and the Pittsburgh Annealing Box Company. Mr. Hunter became a member of the Association in 1931.

CLARENCE D. POLLOCK, a senior member of the Association, passed away on April 30, 1937 in New York City. He was 66 years old. Mr. Pollock was a graduate of Massachusetts Institute of Technology and he served on the engineering staffs of the cities of Newton, Mass.; New York, N.Y.; Havana, Cuba; and San Antonio, Texas. In 1914, he entered private practice as consulting engineer with offices in New York, which practice he carried on until his death.

Mr. Pollock served as chairman of the Committee on Stone Block Pavements from 1927 to 1937, and he was also a member of the Committee on Subgrades and Foundations for Pavements.

JAMES V. MONAHAN, age 52, died in Cincinnati, Ohio, on May 4, 1937. At the time of his death, he was chief engineer and architect of the Public Recreation Commission of Cincinnati. Mr. Monahan graduated from the Massachusetts State University. In 1913 he went to Cincinnati to manage a branch office of a Cleveland landscaping firm. He was appointed to his position with the Recreation Commission in 1932. Under his guidance, the extensive improvements of recreational facilities in Cincinnati were accomplished. He joined the Association in 1936.

Meeting of Board of Directors

Atlanta, Georgia *October 6, 1937*

President Root presided at a luncheon meeting of the Board of Directors held at Atlanta on October 6, 1937. Those present included G. Brown, W. E. Rosengarten, F. T. Paul, J. S. Flockhart, R. L. Phillips, H. D. Bradley, W. J. Galligan, L. W. Herzog, T. Buckley, F. W. Herring, and N. Hebden.

The minutes of the Board meeting of October 3 were read and approved.

The Executive Director discussed the specification for Portland cement concrete pavements which are being revised by this specifications committee and read the comments of the committee members. It was decided that upon clearance with the committee the specifications be forwarded to the Board for approval by correspondence.

A discussion followed as to the work of the Divisions. It was suggested that the Divisions be asked to assist in preparing the program for the annual meeting. Motion passed.

It was moved, seconded and passed that the sewer specifications be submitted to the Board by correspondence upon clearance with the committee in charge of the revision; this clearance to be awaited for a reasonable time.

Mr. Buckley brought up the question of the Association's sending a letter to the President of the Philadelphia Council stressing the fact that the public works department employees in that city are underpaid. It was moved and seconded that a letter be drafted by the President and sent to Philadelphia Council sympathizing with the Philadelphia employees' position and stressing the general fact that pay-cuts should be restored. Motion passed.

W. E. Rosengarten, Chairman of the Resolutions Committee, read the following resolutions which were passed.

Whereas, The City of Atlanta and the members of the Local Arrangements Committee have worked long and earnestly to make this Public Works Congress a profitable and enjoyable one; be it hereby *Resolved* that the American Public Works Association expresses its deep appreciation of the untiring efforts of the officials of the City of Atlanta, the Local Arrangements Committee, espe-

cially the general chairman, Henry J. Cates, and the Ladies Committee under the leadership of Miss Peggy Osborne.

Resolved, That the American Public Works Association strongly endorses the adoption of the merit system of personnel administration in government service including the selection, promotion, and retirement of administrative employees on the basis of merit and hereby authorizes the Board of Directors to cooperate with the governing bodies of other organizations in securing this objective.

Meeting of Executive Committee

Chicago, Illinois *December 11, 1937*

THE Executive Committee of the American Public Works Association met on Saturday, December 11, 1937, at the Congress Hotel in Chicago. J. Eugene Root, President, presided at the meeting which he called to order at 10:00 A.M. Those present were: Thomas Buckley, Guy Brown, R. L. Phillips, F. W. Herring, and N. Hebden.

Selection of Convention City

The Executive Committee gave careful consideration to the tabulated results of the membership questionnaire *re* the Association's annual conference and discussed the comments thereon. It was unanimously agreed that the 1938 convention should be held on the Atlantic seaboard and attention was focused on three cities from which invitations had been received, namely, Baltimore, New York, and Hartford. After a full discussion of the relative merits of each possibility, Mr. Phillips moved that New York City be selected for the 1938 meeting, provided Mr. Carey, chief of the Department of Sanitation, New York, would accept the chairmanship of the local arrangements committee. The motion was passed.

It was decided to hold our conference on Monday, Tuesday, and Wednesday, October 3, 4, and 5. These dates do not conflict with the joint meeting of the New England and New York Sewage Works Associations scheduled for Hartford on October 6, 7, and 8.

It was suggested that a large committee of the older and more well-known members be appointed, on the morning of the opening

day of the conference, to act as greeting committee, introducing the delegates and making sure everyone becomes acquainted.

The Executive Committee discussed committee activities and agreed that program time should be definitely allotted for presenting briefed committee reports. It was also agreed that committee meetings at the conference should be resumed. It was suggested that they be scheduled for Sunday night or at a luncheon meeting.

It was further suggested that luncheon meetings be held, selling tickets as before, to provide a definite time and place for delegates to get together informally.

It was moved and passed that the Executive Director be authorized to negotiate with the local arrangements committee for undertaking the full responsibility of providing the entertainment features, utilizing the sale of exhibit space or other means to raise funds.

Membership Promotion

The members of the Executive Committee discussed at considerable length membership possibilities and the problem of membership promotion efforts. An analysis of the possibilities for the growth of the Association's membership was presented by the Executive Director. This study indicated that about 1300 to 1400 members represents the limit of ultimate membership. Mr. Buckley expressed the opinion that to reach and hold a membership of 1000 would be a reasonable expectancy.

1938 Budget

The Executive Director presented a detailed breakdown of the estimated income and expenditure items established for the 1938 budget. After extended discussion, the Executive Committee unanimously passed Mr. Buckley's motion to adopt the budget as presented.

Report on Manuals of Practice and Sewer Rental Study

A report was presented on the progress of each of the manuals of practice and on the study of sewer rental law administration. It was reported that most of the manuscript of the Street Cleaning Manual is now in the hands of the Committee on Street Cleaning but thus far no comments have been received. Mr. Root stated that he would write each member of the committee and ask for his immediate cooperation in getting comments and suggestions into headquarters.

Depositary for Special Fund—Alternate Signature

A resolution was passed as follows, designating the Merchants National Bank at Meadville, Pennsylvania, as the official depositary for the Special Fund of the Association.

Be it *Resolved,* That the Merchants National Bank of Meadville, Pennsylvania, be and hereby is designated as the official depositary for the Special Fund of the American Public Works Association; said fund to be subject to the order of the Treasurer who is authorized to sign all checks, drafts and orders against this fund in accordance with the resolution of the Board of Directors *re* the Special Fund dated December 28, 1936.

Be it further *Resolved,* That the Executive Director is hereby authorized to sign checks, drafts and orders against this fund as an alternate signature to the Treasurer, in case of illness or death of the latter and subject to the same conditions as set forth in the Resolution of December 28, 1936.

It was agreed that an alternate signature should be provided for on the checks made out on this Special Fund. It was resolved that the Executive Director of the Association be authorized to sign checks made out against the Special Fund in the event of illness or death of the Treasurer of the Association, as an alternate signature to the Treasurer's.

Constitution of the American Public Works Association

I. NAME

The name of the Association shall be "American Public Works Association," and its principal place of business shall be at Chicago, Illinois.

II. PURPOSES

The purposes of the Association shall be the advancement of the theory and practice of the design, construction, maintenance, administration, and operation of public works facilities and services; the dissemination of information and experience upon and the promotion of improved practices in public works administration; the encouragement of the adherence by public works officials to a high professional standard; and the professional and social improvement of its members.

The Association is not organized for profit, and no part of the earnings shall inure to the benefit of any member or officer, except as compensation for services rendered or for necessary expenses actually incurred.

III. MEMBERS

a. *Active*—Any person holding an elective or appointive position on a public body engaged in the field of public works, or being an officer, executive, staff member or consultant to, or a member of the staff of a consultant to, such a body, shall be eligible for Active membership in the Association.

b. *Associate*—Any person having special knowledge, experience or interest in any phase of public works activity shall be eligible for Associate membership.

c. *Senior*—Any member who shall have paid dues continuously for a period of thirty years in the Association and/or the American Society of Municipal Engineers and/or the International Association of Public Works Officials, or who at the time this constitution becomes effective is enrolled as a Senior member of the American Society of Municipal Engineers or as a Life member of the International Association of Public Works Officials, shall be eligible for Senior membership if he so elects and thereafter shall not be required to pay Association dues.

d. *Honorary*—At the recommendation of the Board of Directors and a two-thirds vote of members present at an annual conference, persons may be elected Honorary members of the Association. Those enrolled as Honorary members in the International Association of Public Works Officials at the time this constitution becomes effective shall be continued as Honorary members of this Association.

Only Active and/or Senior members shall be entitled to hold office.

An Active member who retires from official position shall, unless otherwise ordered by the Board of Directors, be retained in his active status.

IV. BOARD OF DIRECTORS AND EXECUTIVE COMMITTEE

The governing body of the Association shall be the Board of Directors, consisting of:

a. The President, First Vice-President, Second Vice-President, and Treasurer of the Association;

b. The Chairman of the Administration Division;

c. The Chairman of the Maintenance and Operation Division;

d. The Chairman of the Design and Construction Division;

e. Four Active or Senior members of the Association at-large elected at the 1937 annual meeting for terms of one, two, three and four years respectively, whose successors shall be elected for a term of four years;

f. The last living Past-President of the Association;

g. Four members of the American Society of Municipal Engineers elected by the Board of Directors of that organization at the 1936 Public Works Congress to serve from January 1, 1937, until the 1937 annual meeting of the Association;

h. Four members of the International Association of Public Works Officials elected by the Board of Governors of that organization at the 1936 Public Works Congress to serve from January 1, 1937, until the 1937 annual meeting of the Association.

The Board of Directors shall be responsible to the membership for the management of the affairs of the Association, and for the promotion of the Association's purposes. It shall have the power of enacting, by a majority vote, such By-Laws as are necessary for the government of the Association.

An Executive Committee, consisting of the last living Past-President, the President, the First Vice-President, the Second Vice-President, and the Treasurer of the Association, shall have the power to exercise all the functions of the Board of Directors between annual meetings and when the Board is not in session.

In the event of a vacancy upon the Board of Directors, the remaining members of the Board shall have power to elect an Active or Senior member to fill the vacancy, to serve until the next annual meeting of members.

V. OFFICERS

The officers of the Association shall be a President, a First Vice-President, a Second Vice-President, and a Treasurer, who shall be Active and/or Senior members elected by letter ballot of the members of the International Association of Public Works Officials and the American Society of Municipal Engineers to serve from January 1, 1937, until the 1937 annual meeting of the Association, and whose successors shall be Active and/or Senior members elected by the members of the Association at the annual meeting for a term of one year.

The Board of Directors shall select an Executive Director and such employees as they may deem proper, to serve at their pleasure, and shall fix their compensation.

In the event of a vacancy occurring in the office of President, the unexpired term shall be filled by the First Vice-President, to be succeeded by the Second Vice-President. In the event of a vacancy occurring in the office of Treasurer, the Board of Directors shall select an Active or Senior member to fill the unexpired term.

VI. DUTIES OF OFFICERS

a. The President shall act as Chairman of the Board of Directors and of the Executive Committee, and shall preside at meetings of the members, except as otherwise ordered by the Board. He shall appoint such standing or special committees as he shall consider necessary or as instructed by the Board of Directors, and shall be, ex-officio, a member of such committees. He shall be responsible to the Board of Directors for the functioning of these committees. He shall sign on behalf of the Association all deeds, contracts and other formal instruments, and shall perform such other duties as may from time to time be assigned to him by the Board of Directors.

b. The Vice-Presidents shall, during the absence of the President or his inability to act, have and exercise all his powers and duties, and shall also perform such other duties as may from time to time be assigned to them by the Board of Directors.

c. The Treasurer shall be the chief financial agent of the Association, and shall exercise authority in all financial matters in accordance with such by-laws and resolutions as may be adopted by the Board of Directors. The Executive Director shall furnish the Treasurer with such financial statements as he may require. The Treasurer shall have the custody of all funds and securities of the Association, including all bonds, stocks, deeds, and other documents, and to this end he may determine the manner of depositing and safe-keeping of the funds and securities of the Association and the system of financial records. The Board of Directors shall fix the amount of the bond to be furnished by the Treasurer, the cost of such bond to be borne by the Association.

d. The Executive Director shall be in charge of the general management of the affairs of the Association subject to this constitution and such regulations as may be adopted by the Board of Directors. He shall collect all fees and other moneys owing to the Association and shall deposit them to the credit of the Association; he shall annually prepare a budget for the Association and upon its approval by the Board of Directors shall have authority to expend the sums appropriated; he shall keep a complete record of all his receipts and expenditures, which shall annually be audited by a firm of certified public accountants and the report submitted to the Board of Directors; he shall give bond in such form and amount as may be determined by the Board of Directors, the cost of such bond to be borne by the Association. He may appoint and discharge any employees or subordinates, and shall fix their compensation within such limits as may be provided by the budget, and may make agreements on behalf of the Association in performing the duties en-

trusted to him. He shall act as Secretary of the Association, shall conduct its correspondence, shall give notice of and keep minutes of all meetings, and shall have custody of the records of the Association and of the corporate seal, and shall attest all instruments. He shall perform such other duties as may be assigned to him by the President and the Board of Directors.

VII. MEETINGS

An annual meeting of the members of the Association shall be held at a time and place to be determined by the Board of Directors. Special meetings shall be held on the call of the President or the Board of Directors, or upon the request in writing of any one hundred and twenty-five Active and/or Senior members. Such special meetings shall be held within thirty days of the receipt of request. The Board of Directors shall have its annual meeting immediately following the annual meeting of the members. Special meetings of the Board of Directors or of the Executive Committee shall be held on the call of the President or on the request in writing of any three members of the Board or Committee.

At least five days' notice of the time, place, and purpose of all meetings shall be given to all persons entitled to notice thereof. Such notice may be given by mail or telegram to the last known address of the person, or personally.

VIII. QUORUM

A majority of the Board of Directors shall constitute a quorum thereof. A quorum of the Executive Committee shall be three members. Twenty members shall constitute a quorum to do business at a meeting of members.

IX. DUES

The annual dues for Active and Associate members shall be as determined from time to time by the Board of Directors, subject to the approval of the membership. Non-payment of dues for two years shall be treated as equivalent to resignation, unless otherwise provided by the Board of Directors, and the name of the member shall be removed from the rolls of the Association, provided at least four weeks' notice is given, during which time he may discharge his obligations and have his membership continued.

X. NOMINATIONS

A Nominating Committee, composed of two members of the International Association of Public Works Officials selected by the Board of Governors of that organization at the 1936 Public Works Congress and two members of the American Society of Municipal Engineers selected by the Board of Directors of that organization at the 1936 Public Works Congress, shall propose the names of candidates for Presi-

dent, First Vice-President, Second Vice-President, and Treasurer to serve from January 1, 1937, until the 1937 annual meeting.

The President, with the approval of the Board of Directors, shall thereafter appoint each year a Nominating Committee of five Active and/or Senior members, which shall propose the names of candidates for all officers and directors-at-large to be voted upon at the annual meeting. Additional nominations may be made from the floor at the annual meeting by any Active member.

XI. DIVISIONS

There shall be three Divisions to provide for the specialized interests of the members of the Association: The Administrative Division, the Design and Construction Division, and the Maintenance and Operation Division. A member of the Association may register in any one or more of the Divisions. Each Division shall be presided over by a Chairman, who shall be elected at the annual meeting by the members registered in that Division. The same person shall not serve as Chairman continuously of the same Division in excess of two years.

The three Divisions shall be managed in conformity with the constitution of the Association and the rules established by the Board of Directors.

XII. CHAPTERS

The Association shall encourage and recognize the establishment of regional, state and local chapters of its members, the purposes of which shall be the furtherance of the objectives of the Association in the region, state or locality. Applications for the establishment of a chapter, together with a copy of the proposed chapter by-laws and a list of those who have agreed to become members of the chapter, shall be submitted to the Board of Directors for approval. Upon notice of approval given by the Board, the chapter shall be considered established.

All chapters shall be managed in conformity with the constitution of the Association and the rules established by the Board of Directors.

XIII. SEAL

The Association shall have a seal which shall bear the legend "American Public Works Association," and the year of incorporation.

XIV. WAIVER OF NOTICE AND ACTION WITHOUT MEETING

Any person entitled to vote at any meeting of members, or of the Board of Directors, or of the Executive Committee, may waive notice of the time, place, and purpose of such meeting either before or after the date of such meeting, and any action taken or resolution adopted thereat shall, upon such waiver, be as valid as though notice had been given.

Any action or resolution which might be taken or adopted at any

meeting of the Board of Directors, Executive Committee, or members, shall be valid if written memorandum of such action or resolution is duly served upon all persons entitled to vote thereon in the manner prescribed for notice of a meeting, and if such action or resolution is approved in writing by a majority of the persons entitled to vote thereon.

XV. AMENDMENTS

Proposed amendments to this constitution must be submitted to the Board of Directors in writing, signed by not less than twenty-five Active and/or Senior members. If the proposed amendment is approved by the Board of Directors, it shall be submitted to the membership for letter ballot. An affirmative vote of two-thirds of the qualified votes cast shall be necessary for the adoption of a proposed amendment.

Association Committees

COMMITTEE ON CITY AND REGIONAL PLANNING

FREDRICK R. STORRER, *Chairman,* City Engineer, Municipal Bldg., Dearborn, Mich.

PIERRE BOUCHER, Secretary, Montreal Metropolitan Commission, Department of Planning & Research, 10 St. James St., W. Montreal, Can.

THOMAS BUCKLEY, Assistant Chief Engineer and Surveyor, Bureau of Engineering, Surveys and Zoning, 1102 City Hall Annex, Philadelphia, Pa.

ARTHUR W. CONSOER, General Manager, Consoer, Townsend & Quinlan, 205 W. Wacker Dr., Chicago, Ill.

TOM G. GAMMIE, Director, Division of State Planning, Oklahoma State Planning Board, State Capitol, Oklahoma City, Okla.

A. J. HAWKINS, Civil Engineer, 4020 Ninth Court, South, Birmingham, Ala.

WALTER A. HEIMBUECHER, City Engineer, City Hall, University City, Mo.

S. C. JACKA, City Engineer, City Hall, Lansing, Mich.

JOSEPH P. SCHWADA, City Engineer, City Hall, Milwaukee, Wis.

W. E. SHEDDAN, City Engineer, City Engineers' Bldg., Jacksonville, Fla.

COMMITTEE ON FIELD ENGINEERING

WALTER STARKWEATHER, *Chairman,* Division Civil Engineering, Seattle Division, U.S. Coast Guard, National Bldg., Seattle, Wash.

LLOYD ALDRICH, City Engineer, Board of Public Works, 600 City Hall, Los Angeles, Calif.

ELMER W. CLARK, Executive Assistant to Assistant Administrator, WPA, 2100 Massachusetts Ave., Washington, D. C.

HERBERT M. DIBERT, Secretary and Treasurer, W. & L. E. Gurley, 514 Fulton St., Troy, N. Y.

H. A. NUNLIST, Chief Engineer, J. A. Stewart Engineering Company, 1011 Traction Building, Cincinnati, Ohio

FREDERICK THOMAS THORPE, JR., Surveyor and Regulator, 1129 Sanger St., Frankford, Philadelphia, Pa.

ARTHUR L. VEDDER, Superintendent of Surveys, Dept. of Public Works, 52 City Hall, Rochester, N. Y.

B. B. WEBER, City Engineer, City Bldg., Oil City, Pa.

COMMITTEE ON STREET PAVING, CONSTRUCTION DESIGN AND MAINTENANCE

GEORGE H. SANDENBURGH, *Chairman,* City Engineer, City Hall, Ann Arbor, Mich.

* As appointed January, 1938.

Arvid Anton Anderson, Manager, Highways and Municipal Bureau, Portland Cement Assn., 33 W. Grand Ave., Chicago, Ill.

Robert B. Brooks, Consulting Engineer, 1517 Mart Bldg., St. Louis, Mo.

Prevost Hubbard, Chemical Engineer, The Asphalt Institute, 801 Second Ave., New York, N. Y.

H. W. Johnston, City Engineer, City Hall, Halifax, Nova Scotia, Can.

George F. Schlesinger, Chief Engineer and Managing Director, National Paving Brick Assn., National Press Bldg., Washington, D. C.

William B. Shafer, Superintendent of Highways and Sewers, City-County Bldg., Pittsburgh, Pa.

Hugh W. Skidmore, Director, Chicago Testing Laboratory, Inc., 536 Lake Shore Dr., Chicago, Ill.

COMMITTEE ON LIGHTING AND PUBLIC SAFETY

Paul Homer Goodell, *Chairman,* Managing Engineer, General Illumination Engineering Co., 3605-07 Carew Tower, Cincinnati, Ohio

W. T. Blackwell, General Lighting Representative, Public Service Electric & Gas Co., 80 Park Place, Newark, N. J.

John F. Gallagher, Accident Analysis Engineer, Division of Traffic Engineering, Dept. of Public Safety, 790 City Hall, Philadelphia, Pa.

Theodore M. Matson, Research Associate, Harvard University Bureau for Street Traffic Research, 29 Holyoke St., Cambridge, Mass.

Nelson I. Raymond, 610 Pine St., Owosso, Mich.

Kirk M. Reid, Illuminating Engineer, Nela Park Engineering Dept., General Electric Co., Cleveland, Ohio

Peter J. Stupka, 2125 G. St., N. W., Washington, D. C.

Stuart R. Williams, Manager, Street Lighting Department, Holophane Co., Newark, Ohio

L. A. S. Wood, Chief Lighting Engineer, Westinghouse Electric & Mfg. Co., 1216 W. 58th St., Cleveland, Ohio

COMMITTEE ON TRAFFIC CONTROL

Burton W. Marsh, *Chairman,* Director, Safety and Traffic Engineering Dept., American Automobile Assn., Pennsylvania Ave. at 17th St., Washington, D. C.

Lewis V. Bullis, Traffic Engineer, Works Progress Administration, 1734 New York Avenue, N. W., Washington, D. C.

John H. Hunter, II, Traffic Signal Engineer, Division of Traffic Engineering, Dept. of Public Safety, 790 City Hall, Philadelphia, Pa.

Frank J. McDevitt, Director, Streets and Sewers, City Hall, St. Louis, Mo.

Theodore M. Matson, Research Associate, Harvard University Bureau for Street Traffic Research, 29 Holyoke St., Cambridge, Mass.

Robert A. Mitchell, Traffic Engineer, Dept. of Public Safety, 790 City Hall, Philadelphia, Pa.

A. J. NAQUIN, Superintendent of Schedules, New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La.

COMMITTEE ON STREET CLEANING

JOHN S. FLOCKHART, *Chairman,* Principal Assistant Engineer, Bureau of Street Cleaning, City Hall, Newark, N. J.

HAROLD D. BRADLEY, Street Commissioner, Department of Street Cleaning, 90 Albert St., Toronto, Ontario, Can.

WILLIAM J. GALLIGAN, Assistant Superintendent, Bureau of Streets, 2840 S. Calumet Ave., Chicago, Ill.

JOSEPH E. GILL, Supervising Engineer, Dept. of Public Works, Ninth Floor, City Hall Annex, Philadelphia, Pa.

ALFRED E. ROCHE, Division Engineer, WPA, 74 Chapel St., Albany, N. Y.

WILLIAM B. SHAFER, Superintendent of Highways and Sewers, City-County Bldg., Pittsburgh, Pa.

WILLIAM ALBERT XANTEN, Supervisor, City Refuse Division, Engineering Dept., District Bldg., Washington, D. C.

COMMITTEE ON SEWERAGE AND SANITATION

DARWIN W. TOWNSEND, *Chairman,* Consulting Engineer, Consoer, Townsend and Quinlan, 757 N. Broadway, Milwaukee, Wis.

HARRY M. BEAUMONT, Supervising Engineer, WPA, 480 Martin St., Philadelphia, Pa.

CARL B. CARPENTER, Superintendent, Dept. of Sanitation, City Hall, Bloomington, Ind.

JAMES L. FEREBEE, Chief Engineer and Manager City Sewerage Comm., Box 2079, Milwaukee, Wis.

JOHN B. HAWLEY, Consulting Civil Engineer, Hawley, Freese and Nichols, 407 Capps Bldg., Ft. Worth, Tex.

CLARENCE E. KEEFER, Principal Assistant to Sewerage Engineer, 1918 Mt. Royal Terrace, Baltimore, Md.

ALBERT P. LEARNED, Assistant Engineer, Black and Veatch, 4706 Broadway, Kansas City, Mo.

P. W. MAETZEL, Chief Engineer, Department of Public Service, City Hall, Columbus, Ohio

MARK B. OWEN, Vice-President, Nichols Engineering and Research Corp. of New York, 40 Wall St., New York, N. Y.

WILLIAM M. PIATT, Consulting Engineer, 111 Corcoran Street Bldg., Durham, N. C.

RUSSELL W. RAGSDALE, P. O. Box 177, Gage, Okla.

THORNDIKE SAVILLE, Dean and Professor of Hydraulic Sanitary Engineering, New York University, Box 65, University Heights, New York, N. Y.

COMMITTEE ON REFUSE COLLECTION AND DISPOSAL

SAMUEL A. GREELEY, *Chairman,* Greeley & Hansen, Consulting Engineers, Suite 1710, 6 N. Michigan Ave., Chicago, Ill.

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GEORGE E. LEAKE, District Superintendent of Streets, 208 S. Racine Ave., Chicago, Ill.

JOHN V. LEWIS, Director of Maintenance and Operation, Dept. of Public Works, 54 Court St., Rochester, N. Y.

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WILLIAM SYDOW, Consulting Engineer, 3461 Main Highway, Miami, Florida

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RALPH C. TAYLOR, Assistant Superintendent, Waste Collection Division, City Hall, Cincinnati, Ohio

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COMMITTEE ON WATER WORKS

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SPECIFICATIONS COMMITTEE ON CEMENT CONCRETE PAVEMENTS

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SPECIFICATIONS COMMITTEE ON STABILIZED ROADS FOR MUNICIPALITIES

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JOHN AMES, City Manager, City Hall, Ames, Iowa

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H. J. LOVE, National Slag Association, 644 Earle Bldg., Washington, D. C.

GEORGE OLDHAM, City Engineer, Baton Rouge, Louisiana

STANTON WALKER, National Sand and Gravel Association, Munsey Bldg., Washington, D. C.

SPECIFICATIONS COMMITTEE ON STONE BLOCK PAVEMENTS

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SPECIFICATIONS COMMITTEE ON STREET RAILWAY PAVEMENTS AND TRACK CONSTRUCTION

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R. C. HARRIS, Commissioner of Works, City Hall, Toronto, Ontario, Can.
C. L. HAWKINS, Superintendent, Maintenance of Way, St. Louis Public Service Co., 3869 Park Ave., St. Louis, Mo.
JOHN L. MARTIN, Superintendent of Track and Roadway, Philadelphia Rapid Transit Company, 2251 N. Ninth Street, Philadelphia, Pa.
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HOWARD C. YOUNG, 10 Genesee Parkway, Cuba, N. Y.

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E. S. RANKIN, Division Engineer, Division of Sewers, City Hall, Newark, N. J.

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P. L. BROCKWAY, *Chairman,* City Engineer, City Hall, Wichita, Kans.
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E. S. Rankin, Division Engineer, Division of Sewers, City Hall, Newark, N. J.

C. W. S. Sammelman, Secretary-Manager, Engineers Club of St. Louis, 4359 Lindell Blvd., St. Louis, Mo.

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W. W. DeBerard, Associate Editor, "Engineering News-Record," 520 N. Michigan Ave., Chicago, Ill.

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Clarence E. Ridley, Executive Director, International City Managers' Association, 1313 E. 60th St., Chicago, Ill.

REPRESENTATIVES IN OTHER ORGANIZATIONS

AMERICAN SOCIETY FOR TESTING MATERIALS

Committee D-4 on Road and Paving Materials.........Julius Adler
Committee C-4 on Clay and Cement Sewer Pipe........E. S. Rankin
Committee C-6 on Drain Pipe Specifications (Sectional Com. A6—1925 A. S. A.)..................................E. S. Rankin
Committee C-13 on Concrete Pipe...................E. S. Rankin
Committee C-9 on Concrete and Concrete Aggregates....Julius Adler
Committee C-3 on Brick.........................George F. Fisk
Committee C-1 on Portland Cement, Specifications and Tests for (Sectional Com. A1—1928, A. S. A.).............E. W. Meckley

NATIONAL RESEARCH COUNCIL

Advisory Board on Highway Research...............W. W. Horner
Committee on Design............................W. W. Horner

U. S. DEPARTMENT OF COMMERCE, DIVISION OF SIMPLIFIED PRACTICE

Paving Brick Committee.........................George F. Fisk
Committee on Grades of Asphalt........................A. W. Dow
Committee on Coarse Aggregates..................Henry L. Howe

AMERICAN STANDARDS ASSOCIATION

Committee on Road Materials (Sectional Com. A-37)...JULIUS ADLER
Conference on Proposed Code of Good Practice for Brick Masonry Work (Sectional Com. A-41)....................ROY L. PHILLIPS
Committee on Safety Code for Grandstands (Sectional Committee Z20)..................................LAURENCE G. LENHARDT
Committee on Administrative Requirements for Building Codes—A55...B. L. CROZIER

AMERICAN ROAD BUILDERS' ASSOCIATION

Committee on Safe Highways........................H. B. BLECK

AMERICAN SOCIETY OF CIVIL ENGINEERS

Committee on Municipal Cleansing.............SAMUEL A. GREELEY
Committee on Street Pavement Economics..........P. L. BROCKWAY

Board of Directors

J. EUGENE ROOT, *President,* Director of Public Works, City Hall, Cincinnati, Ohio

GUY BROWN, *1st Vice-President,* Engineer, Sewer Design, City Hall, St. Louis, Mo.

JOHN S. FLOCKHART, *2nd Vice-President,* Principal Assistant Engineer, Bureau of Street Cleaning, City Hall, Newark, N. J.

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FREDERICK T. PAUL, City Engineer, City Hall, Minneapolis, Minn.

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HENRY L. HOWE, City Engineer, City Hall, Rochester, N. Y.

FRANK W. HERRING, Executive Director, 1313 East 60th Street, Chicago, Ill.

Alphabetical Roster of Members

The following alphabetical list contains the names of all the members of the American Public Works Association. The date in parentheses indicates the year of member's affiliation. The membership classification is active unless Associate (Assoc.), Senior, Life, or Honorary membership is indicated.

Abbot, Munro L. (1931) Senior Surveyor, Bureau of Eng., Surveys & Zoning, 931 W. Lehigh Ave., Philadelphia, Pa.

Adler, Julius (1920) Cons. Engr., 2001 Architects Bldg., 17th & Sansom Sts., Philadelphia, Pa.

Ahrens, Herman F. (Jr.) (Assoc.-1921) Treas., Lock Joint Pipe Co., P. O. Box 21, Ampere, N. J.

Aldrich, Lloyd (1937) City Engr., 600 City Hall, Los Angeles, Calif.

Aldridge, William (1912) Asst. City Engr., 333 McGee St., Winnipeg, Manitoba, Can.

Alexander, Henry F. (1932) City Engr., 366 Oberlin Ave., Lorain, Ohio.

Aloff, Abraham M. (1933) Civil Service Examiner, Room 152, State House, Boston, Mass.

American City Magazine, The (Assoc.-1920) 470 Fourth Ave., New York, N. Y.

Anderson, A. M. (Life-1920) Vice-Pres. & Treas., Elgin Corp., 100 N. LaSalle St., Chicago, Ill.

Anderson, Albert S. (1932) Asst. Supt. of Distribution, 317 Baronne St., New Orleans, La.

Anderson, Arvid Anton (1936) Mgr., Highways & Municipal Bureau, Portland Cement Assn., 33 W. Grand Ave., Chicago, Ill.

Anderson, Robert L. (1935) Supt. of Public Works, Village Hall, Winnetka, Ill.

Andress, George W. (1921) Engr. in Charge, Bureau of Sts., City Hall, Newark, N. J.

Austin-Western Road Machinery Co. (Assoc.-1921) 601 Farnsworth Ave., Aurora, Ill.

Ayres, Louis Evans (1928) Ayres, Lewis, Norris & May, 506 Wolverine Bldg., Ann Arbor, Mich.

Bachmann, Frank (1932) Mgr., Sanitary Eng. Division, The Dorr Co., 221 N. La Salle St., Chicago, Ill.

Baechlin, Ernest (1916) Civil Engr., 35 Lackawanna Place, Bloomfield, N. J.

Baker, Jacob (1935) Pres., United Federal Workers of America, 532 17th St., Washington, D. C.

Baldry, William Ernest (1918) City Engr., 1206 W. 13th St., Topeka, Kans.

Ballantyne, George H. (1928) Comr. of Public Works, City Hall, Syracuse, N. Y.

Ballo, Alfred (Dr.) (Honorary-1935) Director, Dept. of Public Cleansing, Budapest, Hungary.

Barbour, Frank A. (1914) Cons. Engr., 1119 Tremont Bldg., Boston, Mass.

Barbour, J. G. (Assoc.-1911) Secy.-Treas., Metropolitan Paving Brick Co., Canton, Ohio.

Bareuther, Charles A. (1932) Engr. Examiner, Civil Service Com., 975 City Hall, Philadelphia, Pa.

Barnes, H. E. (1920) City Engr., City Hall, Shreveport, La.

Barnes, Sidney B. (1931) Surveyor, 4252 Houghton St., Roxborough, Philadelphia, Pa.

Barr, Warren L. (1938) Asst. Secy.-Treas., Metropolitan Paving Brick Co., Canton, Ohio.

Barrett, Andrew E. (1931) Construction, Technical, Cons. & Designing Engr., Busman Mfg. Co., 4355 Forest Park Blvd., St. Louis, Mo.

Barth, J. Arthur (1937) Managing Clerk, Water Works Dept., 14 City Hall, Rochester, N. Y.

Bartholomew, Tracy (1930) Fellow, Mellon Institute of Industrial Research & Mgr., Research & Tests, Duquesne Slag Products Co., 808 Diamond Bank Bldg., Pittsburgh, Pa.

Bartow, Edward (1920) Prof., Head of Dept. of Chemistry & Chemical Eng., State University of Iowa, Iowa City, Iowa.

Battin, Thomas Wilson (1932) Senior Asst. Engr., Dept. City Transit, 8047 Walker St., Philadelphia, Pa.

Baxter, Samuel S. (1931) Asst. Engr., Bureau of Eng., Surveys & Zoning, 5221 Horrocks St., Philadelphia, Pa.

Baylis, J. R. (1911) Physical Chemist, Bureau of Eng., 1643 E. 86th St., Chicago, Ill.

Beacham, J. G. (1932) Supt. Water Works, City Engr., City Hall, Athens, Ga.

Bean, Ormond R. (1937) City Comr., 414 City Hall, Portland, Ore.

Beaumont, Harry M. (1929) Supervising Engr., WPA, 480 Martin St., Philadelphia, Pa.

Beers, W. D. (1935) City Engr., 401 City & County Bldg., Salt Lake City, Utah.

Beesley, Richard (1932) Second Asst. Surveyor, 439 E. Washington Lane, Philadelphia, Pa.

Bentley, Elroy W. (1937) Civil Engr., 2 School St., Glens Falls, N. Y.

Berry, Benjamin L. (1930) 2130 N. 18th St., Philadelphia, Pa.

Berry, William C. (1931) Cons. Engr., 20 S. Central Ave., Clayton, Mo.

Bieker, Lawrence W. (Assoc.-1937) Structural Engr., The Graver Corp., East Chicago, Ind.

Biery, John M. (1936) City Engr., City Offices, Jackson, Mich.

Biggins, J. C. (1932) City Mgr., City Hall, Newport News, Va.

Bigler, Hugh P. (1932) Director, Rail Steel Bar Assn., 228 N. LaSalle St., Chicago, Ill.

Billingsley, Frederic N. (1929) Cons. Engr., Interstate Bank Bldg., New Orleans, La.

Bird, Byron (1932) Senior Engr., War Dept., 1853 Monroe St., N. W., Washington, D. C.

Biser, D. Benton (1930) Director & Secy., Com. on Governmental Efficiency & Economy, Inc., Mercantile Trust Bldg., Baltimore, Md.

Black, Charles Elmer (1931) Junior Surveyor, 1475 Lardner St., Philadelphia, Pa.

Blackwell, W. T. (1923) General Lighting Rep., Public Service Electric & Gas Co., 80 Park Place, Newark, N. J.

Blanchard, Arthur H. (1909) Cons. Highway Engr. & Traffic Control & Transport Consultant, Box C, Edgewood Station, Providence, R. I.

Bleck, H. B. (1928) City Engr. & Supt. of Water Works, City Hall, Waukegan, Ill.

Bloss, Erwin E. (1931) 1312 International Office Bldg., St. Louis, Mo.

Boatrite, James E. (1929) Structural Engr., 4632 Greene St., Germantown, Philadelphia, Pa.

Bogardus, Theodore S. (1929) Asst. City Engr., City Hall, Meadville, Pa.

Boley, Arthur L. (1931) City Engr., City Hall, Sheboygan, Wis.

Boniface, Arthur (1937) Village Engr. & Mgr., P. O. Box 67, Scarsdale, N. Y.

Booz, Louis P. (1928) Cons. Engr., 263 Madison Ave., Perth Amboy, N. J.

Boucher, Pierre (1937) Secy., Dept. of Planning & Research, Montreal Metropolitan Com., 10 St. James St., W., Montreal, Can.

Bouffard, L. J. (Assoc.-1932) Vice-President & General Mgr., Universal Testing Lab. Co., 506 Keystone Bldg., Pittsburgh, Pa.

Boye, B. L. (Assoc.-1936) Mgr., Asphalt Dept., Socony-Vacuum Oil Co., Inc., 26 Broadway, New York, N. Y.

Bradley, Harold D. (1926) Street Comr., 90 Albert St., Toronto 2, Ontario, Can.

Bradley, James C. (1938) Asst. Supervisor, City Refuse Div., Washington, D. C.

Bragstad, R. E. (1937) City Engr., City Hall, Sioux Falls, S. Dak.

Brennan, W. C. (1909) Pres., Brennan Paving Co., Ltd., 400 Gage Ave., North, Hamilton, Ontario, Can.

Briggs, John (Jr.) (1932) 4736 Large St., Philadelphia, Pa.

Brockway, P. L. (1918) City Engr., City Hall, Wichita, Kans.

Brody, Jacob R. (1932) Draftsman, Bureau of Highways, 514 Ritner St., Philadelphia, Pa.

Brokaw, Arthur (1935) Town Engr., 853 Kearny Ave., Kearny, N. J.

Brokaw, Charles E. (1935) Supt., Highway Maintenance Division, City Hall, Cincinnati, Ohio.

Brooks, Ernest R. (1931) Surveyor, Bureau of Eng., Surveys & Zoning, 931 W. Lehigh Ave., Philadelphia, Pa.

Brooks, Robert B. (1925) Cons. Engr., & Member, Mo. State Highway Com., 1517 Mart Bldg., St. Louis, Mo.

Brown, Charles Carroll (Senior-1895) Cons. Engr., 1400 W. McCormick St., Gainesville, Fla.

Brown, George R. (Assoc.-1933) Brown & Root, Inc., 4300 Calhoun Rd., Houston, Tex.

Brown, Guy (Life-1920) Engr., Sewer Design, City Hall, St. Louis, Mo.

Brown, James F. (1933) Director, Dept. Accounts & Finance, City Hall, Allentown, Pa.

Brown, Prescott G. (1936) Senior Partner, Mason L. Brown & Sons, Civil Engrs., 120 Madison Ave., Detroit, Mich.

Browne, Floyd G. (1936) Sanitary Engr., Box 134, Marion, Ohio.

Brumbaugh, W. Vernon (Assoc.-1927) Secy., National Lime Assn., 927—15th St., N. W., Washington, D. C.

Bryan, Hiram E. (1937) Asst. Engr., City Map Survey, Division of Eng., 238 City Hall Annex, Rochester, N. Y.

Buckley, T. B. (1928) Supt. of Garbage Dept., 3123 Girard Ave., N., Minneapolis, Minn.

Buckley, Thomas (1929) Asst. Chief Engr. & Surveyor, Bureau of Eng., Surveys & Zoning, 1102 City Hall Annex, Philadelphia, Pa.

Buente, C. F. (Assoc.-1926) Concrete Products Company of America, Diamond Bank Bldg., Pittsburgh, Pa.

Bullis, Lewis V. (1932) Traffic Engr., WPA, 1630 R St., N. W., Washington, D. C.

Butler, Joseph J. (1930) Supt., Bureau of Streets, 408 City Hall, Chicago, Ill.

Butler, Orville C. (1932) 730 Buffalo Ave., Niagara Falls, N. Y.

Butterfield, Elmore E. (1921) Chemist, Inventor, 70-04 Dartmouth St., Forest Hills, N. Y.

Button, Joseph T. (1937) Resident Engr. & Inspector, Brookfield, Wis.

Byrum, George R. (Jr.) (1935) Street Com., 217 City Hall, Birmingham, Ala.

Cahill, Ralph H. (1937) Village Comr., Whitefish Bay, 801 E. Lexington Blvd., Milwaukee, Wis.

Caldwell, Wallace L. (1928) Pres., Alabama Asphaltic Limestone Co., Liberty Life Bldg., Birmingham, Ala.

Calhoun, Charles G. (1933) Asst. Supt. of Bldgs., Bd. of Public Education, 5941 Ellsworth St., Philadelphia, Pa.

Campbell, John (Assoc.-1913) Supt., Special Service Dept., Boston Edison Co., 182 Tremont St., Boston, Mass.

Campbell, John Thomas (1931) Surveyor & Regulator, 9th District, Town Hall, Germantown, Philadelphia, Pa.

Carpenter, Carl B. (1926) Supt., Dept. of Sewerage & Sanitation, City Hall, Bloomington, Ind.

Carrigg, W. H. (1925) Supt., Sanitation Dept., City Hall, Sioux City, Iowa

Carter, Henry L. (Assoc.-1933) Pres., Westport Paving Brick Co., Westport, Baltimore, Md.

Carter, Hugh R. (1909) Engr., 607-8 National Standard Bldg., Little Rock, Ark.

Casey, William F. (1935) City Comr., Dept. of Public Works, City Hall, Atlantic City, N. J.

Casteel, Regis Frederick (1935) Asst. Engr., Dept. of Sanitation, 360 Oakland Ave., Pittsburgh, Pa.

Cates, H. J. (1936) Chief, Sanitary Dept., 603 City Hall, Atlanta, Ga.

Cauthorn, W. B. (1932) City Engr., P. O. Box 306, Columbia, Mo.

Cellarius, Frederick J. (1910) Cons. Civil Engr., Cellarius Eng. Bldg., Dayton, Ohio.

Chapin, Ralph S. (1937) Engr., Operation & Maintenance, Main Sewerage Pumping Station, 2nd & N St., Washington, D. C.

Cheney, Clifford C. (1936) City Engr. & Comr. of Public Works, 63 Wilson St., Salamanca, N. Y.

Christ, Edward H. (Senior-1908) Civil & Cons. Engr., Norris Bldg., Grand Rapids, Mich.

Christie, Robert L. (Assoc.-1913) Cons. Engr., Standard Oil Co. of New York, 26 Broadway, New York, N. Y.

Clark, Charles A. (1935) District Engr., Portland Cement Assn., Austin, Tex.

Clark, Edward S. (1921) City Engr., City Hall, Kalamazoo, Mich.

Clark, Elmer W. (1935) Executive Asst. to Asst. Administrator, PWA, Fairfax Hotel, Washington, D. C.

Clayton, John B. (Jr.) (1931) City Engr., Webster Groves, Mo.

Clemmer, H. F. (1926) Engr. of Materials, District Bldg., Washington, D. C.

Cleveland, H. Burdett (Senior-1902) Cons. Sanitary Engr., 518 Fort Washington Ave., New York, N. Y.

Cloud, Harry L. (1937) Director of Public Works, Borough of Dormont, 3330 Beacon Hill Ave., Dormont, Pa.

Coburn, DeWitt M. (1937) Asst. Supt., Dept. of Public Works & Eng., 7745 Freda Ave., Dearborn, Mich.

Cohn, Morris M. (1936) Sanitary Engr., City Hall, Schenectady, N. Y.

Collins, L. W. (1925) Cons. Engr., 332 Washington Ave., Clarksburg, W. Va.

Collins, Thomas E. (1935) City Engr., City Hall, Elizabeth, N. J.

Colwell, Curtis C. (1935) Asst. County Engr., County of Essex, Hall of Records, Newark, N. J.

Conrath, W. G. (1920) Ward Supt., Bureau of Streets, 1623 Monticello Ave., Chicago, Ill.

Consoer, Arthur Wardel (1925) General Mgr., Consoer, Townsend & Quinlan, 205 W. Wacker Drive, Chicago, Ill.

Coons, Perry T. (Assoc.-1925) Mgr., Electrical Wire Rope & Construction Materials Dept., Am. Steel & Wire Co., Rockefeller Bldg., Cleveland, Ohio.

Corning, Dudley T. (1909) Chief, Bureau of Highways, 1001 City Hall Annex, Philadelphia, Pa.

Corson, Alan (1931) Chief Engr. to Comrs., Fairmont Park, Ridgeland, West Park, Philadelphia, Pa.

Corson, H. H. (1936) City Engr. & Treas., Municipal Bldg., Birmingham, Mich.

Corson, S. Cameron (Senior-1908) Supt. of Park, 1439 Powell St., Norristown, Pa.

Costello, James W. (1937) Chief Engr., Dept. Public Affairs, City Hall, Newark, N. J.

Cote, Raymond (1937) Comr. Public Works, City Hall, Woonsocket, R. I.

Cotton, Harry E. (1928) Drainage Engr., Armco Culvert Mfrs. Assn., Middletown, Ohio.

Covas, Perfecto A. (1937) Asst. Engr., Div. Eng., Dept. of Public Works, 52 City Hall, Rochester, N. Y.

Cowden, E. C. (1916) City Engr., City Hall, Harrisburg, Pa.

Cramer, Harry P. (Assoc.-1937) Sales Engr., The Shelt Co., 241 Fair Oaks Ave., Rochester, N. Y.

Cramer, Robert (1925) Cons. Engr., 647 West Virginia St., Milwaukee, Wis.

Cratin, Harry J. (1931) First Asst. Surveyor, Bureau of Eng., Surveys & Zoning, 832 N. 65th St., Philadelphia, Pa.

Craver, H. H. (Assoc.-1914) Mgr., Chemical Div., Pittsburgh Testing Lab., Stevenson & Locust Sts., Pittsburgh, Pa.

Crozier, B. L. (1931) Chief Engr., Dept. of Public Works, 2721 St. Paul St., Baltimore, Md.

Crum, Roy W. (1935) Director, Highway Research Bd., 2101 Constitution Ave., Washington, D. C.

Crumley, H. V. (1935) President, Crumley, Jones & Crumley Co., Blue Ash & Hegner Sts., Deer Park, Cincinnati, Ohio.

Cunniff, John A. (1936) Instrument Man, WPA, General Highways Project 4477, 431 S. 50th St., West Philadelphia, Pa.

Curry, John R. (1935) State Director of Operations, WPA, 1200 Kentucky Ave., Indianapolis, Ind.

Dallas, Harry A. (1937) Asst. City Engr., City Hall, Salisbury, Md.

Dalton, E. L. (Senior-1906) Cons. Engr., 803 Dallas Bank & Trust Bldg., Dallas, Tex.

Daly, Albert F. (1935) Supervisor of Public Works, Town Hall, Millburn, N. J.

Darby, William D. (1935) City Engr., City Hall, West Allis, Wis.

Dauner, Edward J. (1929) Acting Surveyor & Regulator, 4th Survey District, 1606 W. Lehigh Ave., Philadelphia, Pa.

Davis, P. M. (1935) Engr. Inspector, PWA, P. O. Box 73, Cameron, La.

Davison, James Frederick (1935) City Engr., City Hall, Linden, N. J.

Dawes, J. C. (Honorary-1935) Ministry of Health, Whitehall S. W. 1, London, Eng.

DeBerard, W. W. (1926) Assoc. Editor, "Engineering News-Record," 520 N. Michigan Ave., Chicago, Ill.

Delany, Joseph F. (1929) Surveyor & Regulator, 5th District, 4713 N. Mascher St., Philadelphia, Pa.

De Leuw, Charles E. (1920) Charles De Leuw & Co., 20 N. Wacker Drive, Chicago, Ill.

Dempsey, L. E. (1928) Chief, Sanitation Dept., City Hall, Greensboro, N. C.

Depman, Paul H. (1932) Surveyor, 5111 Roosevelt Blvd., Philadelphia, Pa.

Deuchler, Walter E. (1925) Cons. Engr., P. O. Box 51, Aurora, Ill.

DeWitt, Guy C. (1937) Asst. City Engr., 11 Bonnie Brae, Utica, N. Y.

Dey, John R. (1936) Asst. Engr., Cheltenham Township, 305 Ashbourne Rd., Elkins Park, Pa.

Dibert, Herbert M. (1923) Secy.-Treas., W. & L. E. Gurley, 514 Fulton St., Troy, N. Y.

Dingle, James H. (Senior-1908) City Engr., City Hall, Charleston, S. C.

Dodge, James Lynn (1929) 1214 Elm Ave., West Collingswood, N. J.

Dolge, Henry D. (1930) Street Sanitation Supervisor and Foreman, 2154 N. 60th St., Milwaukee, Wis.

Donelson, J. E. (Assoc.-1929) Supt., Concrete Dept., Sloss Sheffield Steel & Iron Co., 1321 N. 21st St., Birmingham, Ala.

Donnelley, L. S. (1937) Engr., Hokianga County, P. O. Box 3, Rawene, N. Z.

Donnelly, Arthur J. (1932) 5453 N. 11th St., Philadelphia, Pa.

Donohue, Jerry (1926) President, Jerry Donohue Eng. Co., 608 N. 8th St., Sheboygan, Wis.

Doremus, Goline (1920) Deputy Chief Engr., Dept. Public Affairs, City Hall, Newark, N. J.

Dorn, William Howard (1932) First Asst. Surveyor, 11 North 50th St., Philadelphia, Pa.

Douglass, Robert M. (1931) Civil & Sanitary Engr., 912 Columbia Bank Bldg., Pittsburgh, Pa.

Dow, A. W. (Senior-1899) Vice Pres. & Chief Engr., Colprovia Roads, Inc., 801 Second Ave., New York, N. Y.

Doyle, Roscoe C. (1935) Regional Project Auditor, PWA, Room 1441-20 North Wacker Drive, Chicago, Ill.

Drake, W. O. (1921) City Engr. & Supt., Dept. of Public Works, City Hall, Corning, N. Y.

Drew, Howard Stebbins (1935) Asst. Regional Administrator, WPA, Rm. 2220 Merchandise Mart, Chicago, Ill.

Dunn, F. B. (Assoc.-1931) 309 Monroe St., Conneaut, Ohio.

Durham, Henry Welles (1913) 31 W. 11th St., New York, N. Y.

Dutton, E. R. (1914) Paving Engr., 3240 Dupont Ave., S., Minneapolis, Minn.

Earhart, Fred A. (1930) Comr. of Public Utilities, City Hall, New Orleans, La.

Earl, George G. (Senior-1906) Cons. Engr., Earl Eng. Co., Whitney Bank Bldg., New Orleans, La.

Eckert, Alfred (1936) Director of Public Works, 3 Jefferson Court, Saginaw, Mich.

Eddy, Dudley B. (1934) 1711 N. 48th St., Seattle, Wash.

Eddy, Harrison P. (Jr.) (1930) Cons. Engr., Metcalf & Eddy, 1300 Statler Bldg., Boston, Mass.

Elgin Corporation, The (Assoc.-1932) 501 Fifth Ave., New York, N. Y.

Elgin Sweeper Company (Assoc.-1932) 5 Oak St., Elgin, Ill.

Ellis, Remington (1937) Junior Asst. Engr., Dept. of Eng., 486 S. Goodman St., Rochester, N. Y.

Ellis, William B. (1935) Route 2, Box 500, San Diego, Calif.

Emerson, C. A. (Jr.) (1917) New York Rep., Geo. B. Gascoigne & Associates, Woolworth Bldg., New York, N. Y.

Emigh, William C. (1937) City Engr., City Hall, Coatesville, Pa.

Engle, Amos B. (1929) Surveyor & Regulator, 10th District, 6000 Rising Sun Ave., Philadelphia, Pa.

Enslow, Linn H. (1931) Vice-President & Editor, "Water Works & Sewerage," 155 E. 44th St., New York, N. Y.

Erickson, D. L. (1926) Director Parks, Public Property & Improvements, City Hall, Lincoln, Nebr.

Erickson, Dewey Henry (1935) Osakis, Minn.

Eschbach, Russel S. (1931) 5244 Ridge Ave., St. Louis, Mo.

Estes, James R. (1936) Asst. City Engr., City Hall, Hattiesburg, Miss.

Ettinger, L. J. (Jr.) (Assoc.-1935) Chief Engr., Eastern Division, International Salt Co., Box 506, Ithaca, N. Y.

Eustance, Harry (1932) Engr., Eastman Kodak Co., 40 Collingwood Dr., Rochester, N. Y.

Evans, Miles E. (1937) Director of Public Service, 227 City Hall, Cleveland, Ohio.

Everett, Chester M. (1932) Fuller & Everett, 22 E. 40th St., New York, N. Y.

Fahy, Charles A. (1931) Surveyor, 1115 Kenwyn St., Philadelphia, Pa.

Faile, Edward Hall (1934) Cons. Engr., 608 Fifth Ave., New York, N. Y.

Farmer, Homer G. (1937) Technical Service Director, Universal Atlas Cement Co., 208 S. LaSalle St., Chicago, Ill.

Farnham, Arthur B. (1931) Comr. of Public Works & City Engr., Pittsfield, Mass.

Farwell, Carroll A. (1928) Fay, Spofford & Thorndike, 11 Beacon St., Boston, Mass.

Faust, Raymond M. (1932) Jr. Surveyor, Bureau of Eng. Surveys and Zoning, 4611 N. Broad St., Philadelphia, Pa.

Felch, Harold E. (1937) Asst. Engr., 270 Terrace Park, Rochester, N. Y.

Fellows, Perry A. (1927) Asst. Chief Engr., WPA, 1937 38th St., Washington, D. C.

Ferebee, James L. (1921) Chief Engr. of City Sewerage Com. & County Metropolitan Sewerage Com., Box 2079, Milwaukee, Wis.

Fisch, Fred W. (1935) Sanitary Engineer, 205 City Hall, Schenectady, N. Y.

Fisher, E. A. (1917) City Engr., City Hall, Lakewood, Ohio.

Fisher, Edwin A. (Senior-1897) Cons. Engr. (retired), 30 Albermarle St., Rochester, N. Y.

Fisher, Harry L. (1933) City Engr., City Hall, Mobile, Ala.

Fisk, George F. (1916) Dist. Mgr., U. S. Housing Authority, 829 Bird Ave., Buffalo, N. Y.

Fitzpatrick, F. Stuart (Assoc.-1935) Mgr., Construction & Civic Development Dept., U. S. Chamber of Commerce, 1615 H St., N. W., Washington, D. C.

Fixmer, Hugh J. (1932) Div. Eng., Bd. of Local Improvements, 2533 N. Bernard St., Chicago, Ill.

Flockhart, John S. (1930) Principal Asst. Engr., Bureau of Street Cleaning, City Hall, Newark, N. J.

Flood, Walter H. (1918) Cons. Chemical Engr., Roads, Pavements, Inspection & Testing of Matls. & Structures, 822 E. 42nd St., Chicago, Ill.

Folwell, A. Prescott (Senior-1901) Editor, "Public Works," 310 E. 45th St., New York, N. Y.

Ford, F. H. (Assoc.-1937) Pres., City Council, P. O. Box 84, Huntsville, Ala.

Foreman, Herbert E. (1931) Asst. Managing Director, Associated General Contractors of America, Munsey Bldg., Washington, D. C.

Fowler, W. S. (1926) Supt. of Sanitation, 2426 Chestnut St., Long Beach, Calif.

Frantz, Louis T. (1932) Electric Engr., Sewerage & Water Bd., 526 Carondelet St., New Orleans, La.

Friel, Francis S. (1926) Albright & Friel, Inc., Cons. Engrs., 1520 Locust St., Philadelphia, Pa.

Frohock, Lawrence W. (1931) Work Supt., Civilian Conservation Corps, Palmyra, Mo.

Fruehauf Trailer Company (Assoc.-1927) 10940 Harper Ave., Detroit, Mich.

Funk, C. S. (1932) Surveyor, Bureau of Eng., Surveys & Zoning, 8031 Frankford Ave., Philadelphia, Pa.

Gabriel, John (Assoc.-1937) Mayor, 422 Blvd., Garfield, N. J.

Gage, Robert B. (1920) Chemical Engr., New Jersey State Highway Lab., P. O. Box 199, Trenton, N. J.

Gaidry, Harold L. (1932) Chief Engr., Gas Dept., New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La.

Gallagher, John F. (1937) Accident Analysis Engr., Dept. of Public Safety, 790 City Hall, Philadelphia, Pa.

Galligan, William J. (1920) Asst. Supt., Bureau of Streets, 2840 S. Calumet Ave., Chicago, Ill.

Gammie, Tom G. (1936) Secy., Okla. Planning & Resources Bd., & Director, Div. of State Planning, Okla. Planning & Resources Bd., State Capitol Bldg., Okla. City, Okla.

Gardiner, Lion (1925) Vice-Pres., Jaeger Machine Co., 560 Spring St., Columbus, Ohio.

Gardner, Clarke (1937) City Engr., City Hall, Salisbury, Md.

Garrett, J. M. (1935) City Engr., 120 Catoma St., Montgomery, Ala.

Garrett, Roy Stuart (1935) Asst. City Engr., City Hall, Montgomery, Ala.

Gascoigne, George B. (1922) Cons. Engr., 1140 Leader Bldg., Cleveland, Ohio, & 1522 Woolworth Bldg., New York, N. Y.

Gearen, M. C. (1929) Bridge Engr., Dept. of Public Works, 300 Cliff Ave., Racine, Wis.

Gerlach, Edward H. (1929) Supt., Garbage Collection & Disposal, 3408 N. 49th St., Milwaukee, Wis.

Gettelman, Fred, Co. (Assoc.-1928) High Speed Snow Plows, 4400 State St., Milwaukee, Wis.

Geupel, Louis A. (1937) City Civil Engr., Director Public Works & Cons. Engr. to Water Dept., City Hall, Evansville, Ind.

Gibbs, Joseph C. (1931) Surveyor, Bureau of Eng., Surveys & Zoning, 7236 Elmwood Ave., Philadelphia, Pa.

Giesey, Jesse K. (1922) Resident Engr., Greeley & Hansen, 31 Lowell Rd., Kenmore, N. Y.

Gill, J. Francis (1928) Comr. of Public Works, City Hall, Oswego, N. Y.

Gill, Joseph E. (1932) Supervising Engr., Dept. of Public Works, Penn Athletic Club, 18th & Locust Sts., Philadelphia, Pa.

Gillett, L. A. (1935) District Director, WPA, 1316 Pendleton St., Cincinnati, Ohio.

Ginnity, William H. (1937) Asst. Engr., 226 City Hall Annex, Rochester, N. Y.

Glynn, James M. (1933) 217 Belmont Rd., Reno, Nev.

Godat, David W. (1936) Maintenance Engr., Dept. of Public Works, 18 City Hall, New Orleans, La.

Good, Raymond C. (1932) Surveyor, 2427 N. Cleveland Ave., Philadelphia, Pa.

Goodell, Paul Homer (Assoc.-1933) Managing Engr., General Illumination Eng. Co., 3605-07 Carew Tower, Cincinnati, Ohio.

Goodrich, Robert M. (Assoc.-1937) Exec. Director, Providence Governmental Research Bureau, 32 Westminster St., Providence, R. I.

Goodridge, Harry (1929) City Engr. & Supt. of Streets, City Hall, Berkeley, Calif.

Gordon, Murray L. (1937) Town Engr., Box 95, Truro, Nova Scotia.

Graddy, J. M. (1935) Supt. of Public Works, 1401 10th Ave., Columbus, Ga.

Graham, Leland L. (1934) Director of Public Works, City Hall, Jamestown, N. Y.

Graham, Ralph C. (1935) Supt. Construction & Public Works, City Hall, Davenport, Iowa.

Grasser, Frank (Jr.) (1930) Supt. of Streets, City Hall, Kenosha, Wis.

Greeley, Samuel A. (1919) Greeley & Hansen, Cons. Engrs., Suite 1710, 6 N. Michigan Ave., Chicago, Ill.

Greenawalt Engineering Company, Inc. (Assoc.-1933) 405 Lexington Ave., New York, N. Y.

Greene, Clark M. (1937) Supt. Public Works & Eng., 13615 Michigan Ave., Dearborn, Mich.

Greenlee, B. I. (1935) Com. of Public Works, City Hall, La Grange, Ill.

Grisi, Adolfo P. (1937) Jefe, Estudios y Projectos, Direccion de Pavimentacion, M.O.P., Bcia, Buenos Aires, LaPlata, Argentina.

Guardia, Carlos Alberto (1937) Ingeniero Sanitario, Ministerio de Sanidad, Apartado 1175, Caracas, Venezuela.

Guillot, Albert H. (1932) Roadway Engr., New Orleans Public Service, Inc., 1423 Adams St., New Orleans, La.

Gulick, Luther (1926) Director, Institute of Public Administration, 302 E. 35th St., New York, N. Y.

Gundlach, George C. (1931) Dist. Office, Bureau of Agricultural Eng., P. O. Box 755, Milwaukee, Wis.

Guyn, J. White (1935) Construction Engr., 375 Aylesford St., Lexington, Ky.

Haas, S. G. Frank (1933) Technical Engr., Sewerage & Water Bd., 526 Carondelet St., New Orleans, La.

Hackett, Allen S. (1930) Cons. Engr., 511 Whitney Bldg., New Orleans, La.

Haddow, A. W. (1928) City Engr., City Hall, Edmonton, Alberta, Can.

Hadley, Henry (1937) City Engr., City Hall, Verdun, Que., Can.

Hafner, Ralph (1929) Designing Traffic Draftsman, Bureau of Police, City Hall, Philadelphia, Pa.

Haldeman, Guy K. (1932) Asst. Engr., 1132 City Hall Annex, Philadelphia, Pa.

Halpin, Eugene (Jr.) (1935) Comr. of Public Works, City Hall, White Plains, N. Y.

Hamilton, Lewis C. (1932) Asst. Engr., Dept. of Public Affairs, 55 Lincoln Ave., Newark, N. J.

Hammersley, W. P. (1919) Supt. of Parks, Municipal Bldg., New Bedford, Mass.

Hancock, Edwin (1926) Cons. Municipal Engr., 1509 Jackson Blvd., Chicago, Ill.

Hansell, William A. (Life-1916) Asst. Chief of Construction & Engr. of Sewers, 737 Woodland Ave., S. E., Atlanta, Ga.

Hansell, William H. (1932) Junior Surveyor, 7707 Fayette St., Philadelphia, Pa.

Hansen, Paul (1913) Greeley & Hansen, Suite 1700, 6 N. Michigan Ave., Chicago, Ill.

Harris, A. Mason (1929) Chief, Bureau of Streets, 1111 E. Broad St., Richmond, Va.

Harris, R. C. (1914) Comr. of Works, City Hall, Toronto, Ontario, Can.

Hartley, G. Russell (1936) City Engr., Municipal Bldg., Englewood, N. J.

Hartmann, Frank J. (1937) Director of Public Works, City Hall, Camden, N. J.

Hasley, Thomas O. (1935) 6773 Fonvard Ave., Pittsburgh, Pa.

Hathaway, A. S. (1936) Asst. Prof., College of Eng., Northwestern Univ., 1930 Sherman Ave., Evanston, Ill.

Haulard, M. V. (1929) Supt. Municipal Repair Plant, 4154 Therville St., New Orleans, La.

Hawkins, A. J. (1922) Civil Engr., 4020 9th Court So., Birmingham, Ala.

Hawkins, C. L. (1920) Supt., Maintenance of Way, St. Louis Public Service Co., 3869 Park Ave., St. Louis, Mo.

Hawley, John B. (1912) Cons. Civil Engr., Hawley, Freese & Nichols, 407 Capps Bldg., Ft. Worth, Tex.

Haydock, Winters (1927) 2117 Huidekoper Place, Washington, D. C.

Hayes, George P. (Jr.) (1931) Asst. Office Engr., Pennsylvania Railroad Co., Berwyn, Pa.

Hayes, Morgan D. (1934) Civil & Hydraulic Engr., 143 Plymouth Ave., Rochester, N. Y.

Haynes, Hugh P. (1925) 1220 E. 5th Ave., Winfield, Kans.

Heald, Henry Townley (1935) Dean & Prof. Civil Eng., Armour Institute of Technology, 3300 Federal St., Chicago, Ill.

Hebden, Norman (1936) Asst. Director, Am. Public Works Assn., 1313 E. 60th St., Chicago, Ill.

Hedtler, Robert S. (1931) Cons. Engr. for Aeronautics, 1420 21st, N. W., Washington, D. C.

Heebink, G. E. (1917) Supervising Engr., Dept. of Public Works, City Offices, Beloit, Wis.

Heide, Joseph (Jr.) (Assoc.-1937) 886 Summit Ave., Jersey City, N. J.

Heideman, A. (1931) Chief Mechanical Engr., Koch Hospital, 4821 Margaretta Ave., St. Louis, Mo.

Heil, Julius P. (Assoc.-1928) Pres., The Heil Co., Milwaukee, Wis.

Heimbuecher, Walter A. (1931) City Engr., City Hall, University City, Mo.

Helm, J. S. (Assoc.-1913) Mgr., Asphalt Sales Dept., Standard Oil Co. of N. J., 26 Broadway, New York, N. Y.

Hempelmann, W. L. (Assoc.-1911) Engr., Asphalt Sales Dept., The Texas Co., 332 S. Michigan Ave., Chicago, Ill.

Herberick, William L. (1931) Second Asst. Engr., Bureau of Eng., Surveys & Zoning, 2766 Kirkbride St., Philadelphia, Pa.

Herring, Frank W. (1935) Executive Director, Am. Public Works Assn., 1313 E. 60th St., Chicago, Ill.

Herzog, Lester W. (1924) State Administrator, WPA, Old Post Office Bldg., Albany, N. Y.

Hess, Edgar B. (1936) Civil Engr., 183 Plum St., Chillicothe, Ohio.

Hess, Wenzel J. (1931) Photographer, Bureau of Highways, 1429 N. 12th St., Philadelphia, Pa.

Hesselbacher, George E. (1934) Cheltenham Township Engr., 8200 Fairview Road, Elkins Park, Pa.

Hibbard, F. Gardiner (1926) Asst. Engr. of Way & Structures, Milwaukee Electric Railway & Light Co., 423 Public Service Bldg., Milwaukee, Wis.

Hicklin, R. G. (1937) Mgr. Municipal Eng. Dept., Robert & Co., 706 Bona Allen Bldg., Atlanta, Ga.

Hicks, Walter F. (1932) City Engr., City Hall, Paris, Tex.

Highland, Scotland G. (1921) Secy., Treas. & General Mgr., Water Bd., Clarksburg, W. Va.

Hill, Theodore C. (1931) Hill & Hill, Engrs., 24½ E. Main St., North East, Pa.

Hincks, Harvey (1937) City Engr., 211 City Hall, Pasadena, Calif.

Hochstadter, Irving (1928) Pres. & Technical Director, Stillman & Van Siclen, Inc., & Hochstadter Laboratories, Inc., 254 W. 31st St., New York, N. Y.

Hodges, Henry G. (1935) Director, Municipal Reference Bureau, City Hall, Cincinnati, Ohio.

Hoffmann, Robert (Senior-1908) Comr. of Eng., 518 City Hall, Cleveland, Ohio.

Hoke, John B. (1929) District Engr., Interstate Amiesite Co., Stewart Bldg., Martinsburg, W. Va.

Hoots, Paul F. (1932) Chief Engr., Eng. Dept., New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La.

Hopkins, Elmer W. (1931) City Engr., City Hall, Salina, Kans.

Horner, W. W. (Life-1915) Cons. Engr. & Prof. Municipal & Sanitary Eng. at Washington University, 1312 International Office Bldg., St. Louis, Mo.

Howe, Henry L. (1926) City Engr., 52 City Hall, Rochester, N. Y.

Howell, Carl L. (1914) Asst. Engr., 427 City Hall, Buffalo, N. Y.

Howland, Charles A. (1923) Staff Engr., Bureau of Municipal Research, 311 S. Juniper St., Philadelphia, Pa.

Howson, L. R. (1926) Cons. Engr., Alvord, Burdick & Howson, 20 N. Wacker Drive, Chicago, Ill.

Hubbard, Prevost (1913) Chemical Engr., Asphalt Institute, 801 Second Ave., New York, N. Y.

Hubbel, Clarence W. (1928) Pres., Hubbel, Roth & Clark, Inc., Cons. Engrs., 2640 Buhl Bldg., Detroit, Mich.

Hudson, Edwin I. (1936) Alderman, 3300 38th Ave., S., Minneapolis, Minn.

Hughes, Charles W. (1920) Cons. Engr., 2147 Fifth St., Port Arthur, Tex.

Hughes, H. Walter (1936) Supervisor, Section Tests & Matls., 34 Court St., Rochester, N. Y.

Hulick, Dan A. (1926) 408 Townes St., Greenville, S. C.

Hunt, Edward M. (1935) Comr. of Public Works, City Engr., City Hall, Portland, Maine.

Hunter, John H. (II) (1937) Traffic Signal Engr., Bureau of Police, Dept. of Public Safety, 790 City Hall, Philadelphia, Pa.

Hurley, J. Raymond (1935) Supt. Public Works, City Hall, Canandaigua, N. Y.

Hyland, N. W. (1930) Asst. Director of Public Works, City Hall, Kansas City, Mo.

International Harvester Company (Assoc.-1932) 180 N. Michigan Ave., Chicago, Ill.

Ireland, C. Eugene (Assoc.-1920) Pres., Birmingham Slag Co., 2019 Sixth Ave., N., Birmingham, Ala.

Jacka, Samuel C. (1937) City Engr., City Hall, Lansing, Mich.

Jackson, M. D. (1937) City Engr., 213 N. 2nd St., Stevens Point, Wis.

Jenkins, Frank L. (1936) City Engr., Municipal Bldg., Portland, Mich.

Jennetty, Adam (1935) Street Comr., City Hall, Perth Amboy, N. J.

Jennings, Irving C. (1929) Pres., Nash Eng. Co., South Norwalk, Conn.

Johns, Walter P. (1928) City Engr., City Hall, Wilkes-Barre, Pa.

Johnson, Andrew K. (1928) Engr. of Highways, Borough of Queens, New York City, 190-24 111th Rd., St. Albans, N. Y.

Johnston, Grant (1936) Gen. Foreman, WPA, 245 Sumac St., Wissahicken, Philadelphia, Pa.

Johnston, H. W. (1937) City Engr., City Hall, Halifax, Nova Scotia, Can.

Joseph, Ben H. (1931) Senior Surveyor, 1152 E. Brill St., Philadelphia, Pa.

Karney, Harry T. (Jr.) (1932) Surveyor, 1132 Bridge St., Philadelphia, Pa.

Kearney, John J. (1926) Cons. Municipal Engr., 3136 Maple Ave., Berwyn, Ill.

Keating, Charles S. (1935) Cons. Engr., 400 City Hall, Syracuse, N. Y.

Keefer, Clarence E. (1922) Principal Asst. to Sewerage Engr., 1918 Mt. Royal Terrace, Baltimore, Md.

Kemmler, E. A. (1922) Advisory Engr., 65 Dodge Ave., Akron, Ohio.

Kendall, Charles H. (1935) State Resident Highway Engr., Box 185, Woodville, Tex.

Kendall, Theodore Reed (1922) Eng. Editor, "The American City" Magazine, 470 Fourth Ave., New York, N. Y.

Kennedy, G. D. (1935) Deputy Comr., in Charge of Business Administration, State Highway Dept., Lansing, Mich.

Kenney, Francis B. (1937) City Surveyor, Dept. of Highways, City Hall, Manchester, N. H.

Kernan, Francis F. (1931) Office Engr., City Engineer's Office, University City, Mo.

Kershaw, William H. (Assoc.-1911) Asst. General Sales Mgr., Asphalt Dept., Texas Co., 135 E. 42nd St., New York, N. Y.

Ketcham, Clarence H. (1934) Chief Supervising Sta. Engr., Dept. of Sanitation, 125 Worth St., New York, N. Y.

Killmer, Albert R. (1932) Transitman, 2828 N. Marston St., Philadelphia, Pa.

King, Oliver L. (1929) Abington Township Engr., Township Bldg., Abington, Pa.

Kleinsteiber, John (1937) City Engr., City Bldg., Canton, Ill.

Klorer, John (1921) Cons. & Planning Engr., Sewerage & Water Bd., 526 Carondelet St., New Orleans, La.

Knapp, Kenneth J. (1936) Asst. Engr., 52 City Hall, Rochester, N. Y.

Knebes, E. L. (1926) Asst. City Engr., Rm. 407 City Hall, Milwaukee, Wis.

Knourek, William (1934) Ward Supt., Bureau of Sts., 2437 Turner Ave., Chicago, Ill.

Koester, Edwin F. (1928) Survey & Traffic Engr., 414 W. 22nd St., Wilmington, Del.

Kohler, George F. (1929) Surveyor & Regulator, 1st Dist., 2010 Rhawn St., Philadelphia, Pa.

Kohler, H. R. (1937) Asst. Engr., 52 City Hall, Rochester, N. Y.

Kohler, Mervin H. (1937) Asst. Engr., Bureau of Eng., Surveys & Zoning, 1232 City Hall Annex, Philadelphia, Pa.

Kohnke, R. B. (1930) Asst. State Engr., Bd. of State Engrs., 207 New Orleans Court Bldg., New Orleans, La.

Kopf, Herbert P. (1937) Asst. Engr., 54 Court St., Rochester, N. Y.

Kramer, Raymond M. (1931) Surveyor, 1713 Dyre St., Frankford, Philadelphia, Pa.

Kriege, H. F. (1930) Technical Director, France Stone Co., 1219 W. Bancroft St., Toledo, Ohio.

Krohn, Herman (1931) Asst. City Planning Engr., 1103 City Hall Annex, Philadelphia, Pa.

Krohne, Arthur D. (Assoc.-1937) 176 S. 66th St., Milwaukee, Wis.

Krupicka, Anton J. (1937) Comr., Dept. of Public Works, 5520 W. Cermak Rd., Cicero, Ill.

Kuhn, Robert J. (1932) Cons. Engr., 1127 Canal Bank Bldg., New Orleans, La.

Laboon, J. F. (1930) Director, County Dept. of Works, Allegheny County, 501 County Office Bldg., Pittsburgh, Pa.

Lafaye, Sidney P. (1932) Office Engr., Drainage Dept., 301 Sewerage & Water Bd. Bldg., New Orleans, La.

Lamson, B. F. (1925) City Engr., City Hall, St. Catharines, Ontario, Can.

Lanahan, Frank J. (Assoc.-1931) Pres., Fort Pitt Malleable Iron Co., P. O. Box 505, Pittsburgh, Pa.

Lancaster, Gilbert (1935) Supervisor of Incinerators, Dept. of Public Works, 2106 Fulton Ave., Cincinnati, Ohio.

Lang, T. S. (1925) City Engr., City Bldg., Clarksburg, W. Va.

Laphen, Morris (1931) District Supt., Bureau of Sts., 2840 S. Calumet Ave., Chicago, Ill.

Latimer, Claude A. (1936) Village Engr., 150 Spencer Place, Mamaroneck, N. Y.

Law, Leroy M. (1928) 460 Paul Brown Bldg., St. Louis, Mo.

Lawler, L. D. (1937) Asst. Engr., Dept. of Eng., 33 Glasgow St., Rochester, N. Y.

Lawlor, Thomas F. (1926) Cons. Engr., 140 South Cherry St., Poughkeepsie, N. Y.

Leahy, P. J. (1932) Deputy Comr. of Public Works, City Hall, Troy, N. Y.

Leake, George E. (1933) Ward Supt., Bureau of Streets, 208 S. Racine Ave., Chicago, Ill.

Learned, Albert P. (1926) Asst. Engr., Black & Veatch, 4706 Broadway, Kansas City, Mo.

Leary, Harry J. (1937) Asst. Director, Dept. of Public Works, 903 City Hall Annex, Philadelphia, Pa.

Lee, Frank O. (1935) Director of Public Works, City Hall, St. Petersburg, Fla.

Lee, R. B. (1918) 29 West 8th St., Hutchinson, Kans.

Leibowitz, David (1932) Asst. Engr., Pres., Borough of Bronx, Div. of Design, 2501 Davidson Ave., Bronx, New York, N. Y.

Lenhardt, Laurence G. (1936) Supt. & General Mgr., Bd. of Water Comrs., City Hall, Detroit, Mich.

Lewis, John V. (1934) Director of Maintenance & Operation, Dept. of Public Works, 54 Court St., Rochester, N. Y.

Lingley, Ralph G. (1920) City Engr., 33 City Hall, Worcester, Mass.

Loewe, Arthur F. (1935) Special Rep., General Electric Co., 1405 Locust St., Philadelphia, Pa.

Longsdorf, Paul Wright (1929) Pres., Paul W. Longsdorf, Inc., 8125 Forrest Ave., Elkins Park, Pa.

Looney, William Henry (1935) City Engr., 517 Jefferson Ave., Stambaugh, Mich.

Love, H. J. (Assoc.-1925) Mgr., National Slag Assn., 644 Earle Bldg., Washington, D. C.

Lovett, Frank Wm. (Assoc.-1933) Sanitary Engr., Link-Belt Co., 300 W. 39th St., Chicago, Ill.

Lovewell, Maurice N. (1912) Asst. Engr., Chicago Park District, 7631 Luella Ave., Chicago, Ill.

Loving, M. W. (Assoc.-1923) Secy., Am. Concrete Pipe Assn., 33 West Grand Ave., Chicago, Ill.

Lyle, John M. (1933) Cons. Engr., 222 S. Mariposa St., Los Angeles, Calif.

Lynch, C. Robert (1931) Chief, Div. of Harbors & Rivers, Dept. of Public Works, State Office Bldg., Providence, R. I.

Lyons, Robert S. (1932) Asst. Engr., Way Dept., Philadelphia Rapid Transit Co., 7162 N. 20th St., Philadelphia, Pa.

Macallum, Andrew F. (Senior-1909) 108 Avenue Rd., Toronto, Ontario, Can.

McCartt, L. E. (1935) City Engr., City Hall, Covington, Ky.

McClelland, J. Bruce (1938) Supt. of Bldgs., The Free Library, Philadelphia, Pa.

McDermott, Charles P. (1929) Chief Clerk, Bureau of City Property, 117 City Hall, Philadelphia, Pa.

McDevitt, Frank J. (1934) Director, Streets & Sewers, City Hall, St. Louis, Mo.

MacDonnell, Charles (1931) Asst. Engr., 5465 Euclid Ave., Philadelphia, Pa.

McElwain, Harold Barnard (1937) Asst. Engr., 125 Falleson Rd., Rochester, N. Y.

McFaul, William Lawrence (1924) City Engr. & Mgr. Water Works, City Hall, Hamilton, Ontario, Can.

McGlensey, William D. (1931) Surveyor, 5827 Upland Way, Philadelphia, Pa.

McGraw-Hill Publishing Company (Engineering News-Record) (Assoc.-1930) 330 W. 42nd St., New York, N. Y.

McJoynt, John A. (1935) General Mgr., Terminal Service Co., 716 First National Bank Bldg., Cincinnati, Ohio.

McKernan, Chas. A. (1931) Comr. Pub. Works, City Hall, Utica, N. Y.

McLaughlin, Martin J. (1928) Director, Public Works, City Hall Annex, Philadelphia, Pa.

McMahon, E. J. (1933) Street Comr., City Hall, St. Louis, Mo.

McMullen, George (1937) Inspector, Dept. of Public Works, 34 Court St., Rochester, N. Y.

McVea, J. C. (1919) Municipal Improvements Engr., 1318 Kipling St., Houston, Tex.

Maetzel, Paul W. (1935) City Engr., City Hall, Columbus, Ohio.

Magliano, Hilario (Dr.) (Assoc.-1937) Decano de la Facultad de Ciencias Fisicomatematics, Calle 47, esquinas 1, LaPlata, Argentina.

Mahony, J. J. (1921) City Clerk, St. Johns, Newfoundland.

Maier, Harry L. (1919) Chief Engr., Street & Sewer Dept., 229 N. Connell St., Wilmington, Del.

Mall, Ivor O. (1929) Ebasco Service, Inc., 2 Rector St., New York, N. Y.

Mallery, Earl D. (1936) Mgr., Washington Office, Am. Municipal Assn., 521-26 Transportation Bldg., Washington, D. C.

Manion, John R. (1932) Supt. Waste Collection, 1342 Covedale Ave., Cincinnati, Ohio.

Mann, Karl M. (Assoc.-1930) Pres., Case-Shepperd-Mann Publishing Corp., 24 W. 40th St., New York, N. Y.

Mansfield, Myron G. (1933) Vice-Pres. & Secy., Morris Knowles, Inc., 507 Westinghouse Bldg., Pittsburgh, Pa.

Manship, Horace H. (1932) Principal Asst. Surveyor, Clarkson Ave. & Wister St., Philadelphia, Pa.

Manzler, Adam T. (1936) Secy. to Comr. of Public Works, City Hall Annex, Rochester, N. Y.

Marker, James R. (Senior-1907) Chief Engr., Ohio Paving Brick Mfrs. Assn., 510 Hartman Bldg., Columbus, Ohio.
Marks, Nathaniel L. (Jr.) (1936) City Engr., 21 City Hall, New Orleans, La.
Marsh, Burton W. (1931) Director, Safety & Traffic Eng. Dept., Am. Automobile Assn., Pennsylvania Ave. at 17th St., Washington, D. C.
Marston, Frank A. (1922) Partner, Metcalf & Eddy, 1300 Statler Bldg., Boston, Mass.
Marth, Oscar (1936) Asst. Supervisor, Section Tests & Matls., Dept. of Public Works, 34 Court St., Rochester, N. Y.
Martin, Carl H. (1931) Cons. Engr., Barton & Martin, Engrs., Architects Bldg., Philadelphia, Pa.
Martin, E. F. (1935) City Engr., City Hall, Montclair, N. J.
Martin, George E. (1933) Cons. Engr., The Barrett Co., 40 Rector St., New York, N. Y.
Martin, John L. (1932) Engr. of Way, Philadelphia Rapid Transit Co., 2251 North 9th St., Philadelphia, Pa.
Martin, Ralph F. (1932) Surveyor, Bureau of Eng., Surveys & Zoning, 7331 Walnut Lane, Philadelphia, Pa.
Martini, Nicholas (1938) Director of Public Works, Municipal Bldg., Passaic, N. J.
Marvin, Charles W. (1937) Asst. Engr., 52 City Hall, Rochester, N. Y.
Marvin, John H. (1935) Supt. of Records, Dept. of Public Works, 345 City Hall, Cincinnati, Ohio.
Masterson, Leo J. (1931) Asst. City Planning Engr., Bureau of Eng., Surveys & Zoning, 3608 N. 19th St., Philadelphia, Pa.
Mastriani, Samuel G. (1935) Cons. Engr., Dunmore & Throop Boroughs, Borough Bldg., Dunmore, Pa.
Matson, Theodore M. (1931) Bureau for Street Traffic Research, Harvard University, 29 Holyoke St., Cambridge, Mass.
Matzat, Francis H. (1937) Asst. Engr., 52 City Hall, Rochester, N. Y.
Maxcy, Charles J. (1935) Chief Accountant, PWA, 1629 Columbia Rd., N. W., Washington, D. C.
Meade, Harold E. (1932) General Sales Mgr., New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La.
Mebus, Charles F. (1920) Cons. Engr., 112 S. Easton Road, Glenside, Pa.
Meck, William L. (1931) Principal Asst. Surveyor, Bureau of Eng., Surveys & Zoning, 7926 Loretto Ave., Philadelphia, Pa.
Meckley, E. W. (1925) City Engr., City Hall, Allentown, Pa.
Metz, Herbert H. (1926) Borough Engr., 20 S. Richardson Ave., Lansdale, Pa.
Meyers, Dudley C. (1923) 3039 E. 91st St., Chicago, Ill.
Mickle, D. Grant (1935) Mgr., Traffic & Transport Dept., Jensen, Bowen & Farrell, & Asst. Director, Mich. Highway Planning Survey, Michigan Theatre Bldg., Ann Arbor, Mich.
Miller, C. H. (Assoc.-1923) Mgr., Vitrified Dept., Laclede Christy Clay Products Co., 1711 Ambassador Bldg., St. Louis, Mo.

Miller, Edwin A. (1926) Supervisor of Maint., Dept. of Public Works, City Hall Annex, Rochester, N. Y.

Miller, J. Strother (Assoc.-1913) Director, Technical Bureau, The Barber Co., Inc., Barber, N. J.

Miller, W. C. (1937) City Engr. & Treas., City Hall, St. Thomas, Ontario, Can.

Mintzer, Howard K. (1936) Supervising Estimator, Bureau of Highways, 5312 Oxford St., West Philadelphia, Pa.

Mitchell, Louis (1935) Dean of Eng. & Cons. Engr., College of Applied Science, Syracuse University, Syracuse, N. Y.

Mitchell, Robert A. (1931) Traffic Engr., Dept. of Public Safety, 790 City Hall, Philadelphia, Pa.

Mockler, John T. (1928) First Asst. Engr., 401 City Hall, Buffalo, N. Y.

Moe, Gustave A. (1928) Chief of Field Staff, Public Administration Service, 11 Beacon St., Boston, Mass.

Mohr, Arthur W. (1932) Dist. Mgr., Am. Bitumuls Co., P. O. Box 1108, Baton Rouge, La.

Mohr, John (1935) Asst. Engr., Dept. of Sanitation, 1213 Throgmorton Ave., Bronx, New York, N. Y.

Mondello, Anthony G. (Assoc.-1932) Mgr., Dependable Eng. & Contracting Co., 156 W. Cumberland St., Philadelphia, Pa.

Moorhouse, John H. (1936) Supt., Dept. of Public Service, 30 Gerald Ave., Highland Park, Mich.

Morrison, Thomas J. (1934) 373 Grand Ave., Rochester, N. Y.

Moser, Albert W. (1931) Asst. City Planning Engr., Bureau of Eng., Surveys & Zoning, 1103 City Hall Annex, Philadelphia, Pa.

Moulthrop, H. R. (1936) Asst. Engr., Dept. of Public Works, 34 Pinnacle Rd., Rochester, N. Y.

Mulryan, David E. (1936) Asst. Engr., Dept. of Public Works, 426 Bay St., Rochester, N. Y.

Mulvihill, Francis J. (1928) 1028 Connecticut Ave., N. W., Washington, D. C.

"Municipal Sanitation" (Assoc.-1930) 24 West 40th St., New York, N. Y.

Murray, Edward J. (1934) Director of Public Works, City Hall, Yonkers, N. Y.

Murray, Matt S. (1926) Missouri Works Progress Administrator, 5800 Wyandotte, Kansas City, Mo.

Mussina, Lyons (1936) City Engr., 715 Campbell St., Williamsport, Pa.

Myers, Ernest S. (1932) Asst. to Pres., New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La.

Naquin, Arthur J. (1932) Transportation Engr., New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La.

Neeson, John H. (1925) Chief Engr. & Surveyor, Bureau of Eng., Surveys & Zoning, 1103 City Hall Annex, Philadelphia, Pa.

Neis, Robert E. (1936) City Director, City Hall, Monroe, Mich.

Nelson, J. Harry (Assoc.-1937) City Mgr., City Hall, Bay City, Mich.

Nemoyer, J. W. (1930) Asst. Engr., Greeley & Hansen, 6 N. Michigan Ave., Chicago, Ill.

Nevin, John H. (1931) First Asst. Engr., Bureau of Eng., Surveys & Zoning, 1625 Cayuga St., Philadelphia, Pa.

Nichols, A. C. (Assoc.-1937) City Manager, City Hall, Clearwater, Fla.

Nichols, Charles S. (1937) Director Public Service & City Engr., City Hall, Miami, Fla.

Nier, Edward F. (1936) Chief Clerk, Comr's. Office, Dept. of Public Works, 54 Court St., Rochester, N. Y.

Nilles, Philip C. (1932) Supt. of Equipment, Bureau of Streets, 2324 S. Ashland Ave., Chicago, Ill.

Noack, Arthur (1926) Cons. Municipal Engr., & State Director of N. J. Geodetic Control Survey & Cons. Engr., 60 Outwater Lane, Garfield, N. J.

Norton, James G. (1934) City Engr., City Hall, Kingston, N. Y.

Nosky, Richard F. (1937) City Engr., City Hall, North Platte, Nebr.

Nowlan, Hume K. (1935) Exec. Secy., West Virginia League of Municipalities, Box 427, Charleston, W. Va.

Nunlist, H. A. (Assoc.-1935) Pres., J. A. Stewart Eng. Co., 1011 Traction Bldg., Cincinnati, Ohio.

Nutting, H. C. (1919) Pres., The H. C. Nutting Co., 4120 Davis Lane, Cincinnati, Ohio.

Nye, George H. (1925) Municipal Bldg., New Bedford, Mass.

Nygard, Carl O. (1929) Supt. of Incineration, Riverside Destructor, 28th and Pacific Sts., Minneapolis, Minn.

O'Brien, D. F. (1930) Alderman, 1218 University Ave., N. E., Minneapolis, Minn.

Ogden, W. H. H. (Jr.) (1929) Surveyor & Regulator, 3rd District, 1129 City Hall Annex, Philadelphia, Pa.

Ohrt, Frederick (1935) Mgr. & Chief Engr., Bd. of Water Supply, P. O. Box 3347, Honolulu, T. H.

Older, T. Fred (1936) Mgr. of Public Utilities, 125 W. Michigan Ave., Ypsilanti, Mich.

Oldham, George E. (1937) City Engr., City Hall, Baton Rouge, La.

Oliver, Elmer L. (1936) Asst. Engr., Dept. of Public Works, 52 City Hall, Rochester, N. Y.

Olmsted, Frederick Law (1909) Landscape Architect, Olmsted Bros., 99 Warren St., Brookline, Mass.

Olsen, William C. (1923) Cons. Engr., P. O. Box 271, Raleigh, N. C.

Olson, Herbert A. (1936) Mich. Municipal League, 205 S. State St., Ann Arbor, Mich.

O'Reilly, Andrew J. (1931) Public Safety Engr., 2207 S. Grand Blvd, St. Louis, Mo.

Orput, Raymond A. (1935) Cons. Architect & Engr., Third National Bank Bldg., Rockford, Ill.

Ostrander, V. L. (1929) Asst. Mgr., Asphalt Sales Dept., Shell Union Oil Corp., 50 W. 50th St., New York, N. Y.

Outzen, A. N. (1926) Supt. River Rouge Plant, Detroit City Gas Co., & Supt. Natural Gas Receiving Station, P. O. Box 96, Dearborn, Mich.
Owen, Mark B. (1928) Vice-Pres., Nichols Eng. & Research Corp. of New York, 7752 Kentucky Ave., Dearborn, Mich.
Paffrath, Ernest H. (1929) Asst. Sewer Comr., 2322 Clark Ave., St. Louis, Mo.
Palmer, I. Charles (1931) Div. Engr., Div. of Sewers, 423 City-County Bldg., Pittsburgh, Pa.
Pardon, W. W. (1935) Dist. Engr., State Highway Dept., Versailles, Ky.
Parent, Arthur (Senior-1905) Consultant to City Electrical Dept., 4935 Queen Mary Road, Montreal, Quebec, Can.
Paterson, A. B. (1929) Pres., New Orleans Public Service Inc., 317 Baronne St., New Orleans, La.
Patton, Marion C. (1933) Chief Engr., Armco Culvert Mfrs. Assn., 701 Curtis St., Middletown, Ohio.
Patzig, Monroe L. (1918) Cons. Engr. & Mgr., Patzig Testing Laboratories, 2215 Ingersoll Ave., Des Moines, Iowa.
Paul, Frederick T. (1930) City Engr., 203 City Hall, Minneapolis, Minn.
Paulson, D. O. (Assoc.-1921) Pres., Municipal Supply Co., 2508-18 S. Main St., South Bend, Ind.
Pearce, Irving C. (1937) Comr. Public Works, City Hall, St. Paul, Minn.
Pearse, Langdon (1919) Sanitary Engr., Sanitary Dist. of Chicago, 910 S. Michigan Ave., Chicago, Ill.
Pease, Fred A. (1926) Pres., F. A. Pease Eng. Co., 1211 Terminal Tower, Cleveland, Ohio.
Peck, Leon F. (1913) Supt. of Streets & Supt. Highways, Metropolitan District, Hartford County, Municipal Bldg., Hartford, Conn.
Peirce, Walter A. (1936) Mgr., Water Dept., City Hall, Racine, Wis.
Pennybacker, J. E. (Assoc.-1919) Managing Director, The Asphalt Institute, 801 Second Ave., New York, N. Y.
Perkins, G. Howard (Senior-1905) Secy., Warren Bros. Co., P. O. Box 1869, Boston, Mass.
Perkins, William C. (Senior-1907) Chief Engr., Eastern Paving Brick Assn., Langhorne, Pa.
Perrine, J. Franklin (1921) Engr. of Sewers, Borough of Queens, Borough Hall, Long Island City, N. Y.
Perring, Henry G. (1921) Cons. Engr., Perring & Remington Co., 10 W. Chase Ct., Baltimore, Md.
Philips, James H. (1931) Chief Engr., Essex County Park Com., 115 Clifton Ave., Newark, N. J.
Phillips, Cornelius W. (1933) Supt., Dept. of Sts. & Eng., 36 Court St., Springfield, Mass.
Phillips, James (Jr.) (1934) Supt., Incineration, P. O. Box 4, Yonkers, N. Y.
Phillips, Roy L. (1918) City Engr., City Bldg., Meadville, Pa.
Piatt, William M. (1926) Cons. Engr., Rm. 1205, 111 Corcoran St. Bldg., Durham, N. C.
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Pinel, Stanley I. (1936) Research Director, Am. Public Works Assn., 1313 E. 60th St., Chicago, Ill.

Pinker, George W. (1932) District Supt., Bureau of Street Cleaning, 5328 N. Camac St., Philadelphia, Pa.

Pittsburgh-Des Moines Steel Company (Assoc.-1930) Neville Station, Pittsburgh, Pa.

Polk, Wesley W. (1936) Comr. Public Works, Comr. Streets & Supt. Water Dept., City Hall, Evanston, Ill.

Pollock, James R. (1935) City Mgr., & Director of Public Works & Utilities, City Hall, Flint, Mich.

Porter, John Francis (1935) Supt. Property Maintenance, Dept. of Public Works, City Hall, Cincinnati, Ohio.

Post, Ruden W. (1937) Supt. St. Lighting, 34 Court St., Rochester, N. Y.

Potter, Alexander (1922) Cons. Sanitary & Hydraulic Engr., 50 Church St., New York, N. Y.

Powell, John M. (1922) City Engr., City Hall, Elyria, Ohio.

Prince, Elmer W. (1935) City Mgr. & City Engr., City Hall, Morgantown, W. Va.

Quinlan, Patrick H. (1932) Drainage Engr., Sewerage & Water Board, 526 Carondelet St., New Orleans, La.

Quirk, J. Henry (1937) City Engr., City Bldg., Bradford, Pa.

Raffety, J. S. (1936) Sewer Engr., U. S. Resettlement Administration, 3414 Oakview Place, Cincinnati, Ohio.

Ragsdale, Russell W. (1932) Resident Engr. Inspector, PWA, Gage, Okla.

Rainville, Walter S. (Jr.) (Assoc.-1932) Railway Dept., New Orleans Public Service, Inc., 317 Baronne St., New Orleans, La.

Raisch, William (1926) Cons. Engr., 227 Fulton St., New York, N. Y.

Rambo, Nathan H., Jr. (1932) Supt. of Maintenance, Bureau of City Property, 117 City Hall, Philadelphia, Pa.

Rangel, L. A. de Souza (1936) Chief Engr., Dept. of Public Works, Rua Buenos Ayres, No. 93-3 andar, Rio de Janeiro, Brazil.

Rankin, E. S. (Senior-1903) Div. Engr., Div. of Sewers, City Hall, Newark, N. J.

Ratcliffe, Robert C. (1937) Chief, Dept. Public Works, City Hall, Grand Junction, Colo.

Raymond, Nelson I. (1936) 610 Pine St., Owosso, Mich.

Reid, Kirk M. (Assoc.-1923) Illuminating Engr., Nela Park Eng. Dept., General Electric Co., Cleveland, Ohio.

Reidenbach, Fred W. (1936) Asst. Engr., 52 City Hall, Rochester, N. Y.

Reilly, James L. (1926) Deputy Comr. of Public Works, 18 City Hall, New Orleans, La.

Renard, Eugene Charles (1931) Res. Engr. Inspector, PWA, 480 Oakwood, Webster Groves, Mo.

Reppert, Charles M. (1921) Cons. Engr., 724 S. Negley Ave., Pittsburgh, Pa.

Requardt, G. J. (Life-1921) Cons. Engr., Whitman, Requardt & Smith, Biddle St. at Charles, Baltimore, Md.

Rice, John M. (1918) Cons. Engr., 2502 Grant Bldg., Pittsburgh, Pa.
Richards, Arthur (1928) Engr. Exec., Municipal Bldg., Larchmont, N. Y.
Richter, Louis (Assoc.-1935) Pres., The Richter Concrete Corp., 1249 West 7th St., Cincinnati, Ohio.
Ridgway, Robert (Senior-1902) Cons. Engr., 24 Gramercy Park, New York, N. Y.
Ridley, Clarence E. (1919) Executive Director, The International City Managers Assn., 1313 E. 60th St., Chicago, Ill.
Riehl, W. H. (1928) City Engr., City Hall, Stratford, Ontario, Can.
Rigsby, R. W. (1935) Executive Officer, Farm Credit Administration, 1300 E. St. N. W., Washington, D. C.
Roberts, W. H. (1937) Comr. of Public Works, City Hall, Rochester, N. Y.
Robertson, Russel A. (1933) Structural Draftsman, 1240 Sanger St., Philadelphia, Pa.
Robinson, David L., Jr. (1935) Asst. Director, Public Administration Service, 1313 E. 60th St., Chicago, Ill.
Robinson, John H. (1932) Surveyor, 451 Seville St., Philadelphia, Pa.
Roche, Alfred E. (1931) Div. Engr., WPA, 1604 Peoples Ave., Troy, N. Y.
Root, A. H. (1935) 132 W. Riverside Dr., Newport, Ky.
Root, J. Eugene (1932) Director of Public Works, 104 City Hall, Cincinnati, Ohio.
Roquemore, Bruce (1935) City Engr., City Hall, Lakeland, Fla.
Rosen, Milton (1931) Milton Rosen Tire & Rubber Co., 147 W. 6th St., St. Paul, Minn.
Rosenberg, Joseph H. (1932) Second Asst. Surveyor, Bureau of Eng. Surveys & Zoning, 1223 City Hall Annex, Philadelphia, Pa.
Rosengarten, Walter E. (1929) Lower Merion Township Engr., Township Bldg., Ardmore, Pa.
Rouse, Raymond J. (1935) Supervisor of Equipment, Dept. of Public Works, City Hall, Cincinnati, Ohio.
Rowe, Ernest J. (1931) Supt., Water & Light Dept., 110 Maple Ave., Wellsville, N. Y.
Rowe, Frank (1937) Supt. of Motor Equipment of Public Works, 531 Frost Ave., Rochester, N. Y.
Ruhling, George H. (1938) Municipal Engr. on Design & Maintenance, State Highway Dept., Lansing, Mich.
Rush, Benjamin F. (1933) Chief Engr., Dept. Public Works, City Hall, Honolulu, T. H.
Ryder, Ely M. T. (1922) Way Engr., Third Ave. Railway Co., 2396 Third Ave., New York, N. Y.
Samenfink, Herman J. (1937) Supt. of Ash & Rubbish Collection, Dept. of Public Works, 54 Court St., Rochester, N. Y.
Sammelman, C. W. S. (Life-1915) Secy. Engrs.' Club of St. Louis, 4359 Lindell Blvd., St. Louis, Mo.
Samuel, T. D. (Jr.) (1930) Chief Engr. & Supt., Water Dept., 442 W. 68th St., Kansas City, Mo.

Sanborn, George H. (1936) Deputy Comr., Public Works, 315 DeForest Road, Syracuse, N. Y.

Sandenburgh, George H. (1923) City Engr., City Hall, Ann Arbor, Mich.

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Sauer, August (1932) Engr., 412 Trenton Ave., San Antonio, Tex.

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Schaut, George G. (1932) Chief Chemist, Philadelphia Water Bureau, Belmont Ave. & Ford Rd., Philadelphia, Pa.

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Shimoda, Yoshito (Dr.) (1937) Director, Osaka Municipal Hygienic Lab., Osaka, Japan.

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Silva Freire, Victor da (1922) Pres., Humus Ltd., Sewerage & Sanitary Developments, Caixa 18, Sao Paulo, Brazil.

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Skelly, Joseph P. (1930) Comr. of Public Property, City Hall Annex, New Orleans, La.

Skidmore, Hugh W. (1921) Pres., Chicago Testing Lab., Inc., 536 Lake Shore Drive, Chicago, Ill.

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Smith, Leon A. (1930) Supt., Water Works, City Hall, Madison, Wis.

Smith, Meloy (1937) Cons. Engr., 16 State St., Rochester, N. Y.

Smith, Nathan L. (1937) Chief Engr., Maryland State Roads Com., Federal Reserve Bank Bldg., Baltimore, Md.

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Soper, George A. (1931) Cons. Engr., Middle Neck Rd., Great Neck, N. Y.

Sowers, George B. (1929) Cons. Engr., 1836 Euclid Ave., Cleveland, Ohio.

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Stanley, George C. (1937) City Engr. & Supt. Streets, City Hall, Burlington, Vt.

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Stapley, Edward R. (1926) Prof., Civil Eng., Okla. Agricultural & Mechanical College, 27 College Circle, Stillwater, Okla.

Starkweather, Walter (1928) Dir. Civil Eng., Seattle Div. U. S. Coast Guard, Room 1, National Bldg., Seattle, Wash.

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Stewart, John R. (1923) Town Engr., Box 447, Renfrew, Ontario, Can.

Stewart, S. W. (Assoc.-1921) Pres., Ambursen Construction Co., 295 Madison Ave., New York, N. Y.

Stilson, Alden E. (Assoc.-1929) Pres., Morse-Boulger Destructor Co., 202 East 44th St., New York, N. Y.

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Stone, W. Allen (1935) County Engr., Hamilton County, Court House, Cincinnati, Ohio.

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Storrie, William (1920) Cons. Civil Engr., Gore & Storrie, 1130 Bay St., Toronto, Ontario, Can.

Stout, Dayton Frank (1931) Surveyor, 428 Lyceum Ave., Roxborough, Philadelphia, Pa.

Stucke, John (1937) Supt. Garbage Collection, Dept. of Public Works, 99 Versailles Rd., Rochester, N. Y.

Stupka, Peter J. (1932) 2125 G St., N. W., Washington, D. C.

Sullivan, Thomas F. (Col.) (1919) Chairman, Bd. of Transit Comrs., 1 Beacon St., Boston, 9, Mass.

Summers, George J. (1934) 1266 Seneca St., Buffalo, N. Y.

Swift, William P. (1931) 912 E. Scattergood St., Philadelphia, Pa.

Sydow, William (1928) Cons. Engr. 3461 Main Highway, Miami, Fla.

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Tark, M. B. (Assoc.-1923) Engr., Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

Taylor, G. E. (1930) Deputy Street Comr., 90 Albert St., Toronto, Ontario, Can.

Taylor, Henry W. (1935) Cons. Engr., 11 Park Place, New York, N. Y.

Taylor, Ralph C. (1934) Asst. Supt., Waste Collection Div., Room 350, City Hall, Cincinnati, Ohio.

Tehan, Joseph J. (1931) Resident Engr., Construction of Intercepting Sewers & Sewage Treatment Plant & Cons. Engr., 4 Sheridan St., Auburn, N. Y.

Tenney, George O. (Assoc.-1913) Pres., Atlantic Bitulithic Co., 645-648 Munsey Bldg., Washington, D. C.

Theard, Alfred F. (1932) General Supt., Sewerage & Water Bd., Sewerage & Water Bd. Bldg., New Orleans, La.

Thomas, Frank L. (1931) Professional Engr., 539 E. Hermitage St., Roxborough, Philadelphia, Pa.

Thorburn, Walter (Assoc.-1932) Instrument Man, 2030 Ingersoll Place, Seattle, Wash.

Thorpe, Frederick Thomas (Jr.) (1929) Surveyor & Regulator, 1129 Sanger St., Frankford, Philadelphia, Pa.

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Tolles, William H. (1934) Supt. of Streets., Municipal Bldg., Nashua, N. H.

Tomlinson, Reuben C. (1932) Junior Surveyor, 3653 N. Darien St., Philadelphia, Pa.

Tomlinson, W. S. (1926) City Engr., City Hall, Columbia, S. C.

Torrance, Langham (1931) Surveyor, 6th Survey District, 931 W. Lehigh Ave., Philadelphia, Pa.

Townsend, Alfred A. (1932) Asst. Engr., Dept. of City Transit, 718 Carpenter Lane, Mt. Airy, Philadelphia, Pa.

Townsend, Darwin W. (1931) Cons. Engr., Consoer-Townsend & Quinlan, 757 N. Broadway, Milwaukee, Wis.

Transeau, Theodore E. (1932) Asst. Director, Dept. of Public Safety, 221 City Hall, Philadelphia, Pa.

Traver, Raymond B. (1936) Onondaga County Supt. of Highways, 105 Court House, Syracuse, N. Y.

Trustin, Harry (1934) City Engr. & Supt. Public Improvements, City Hall, Omaha, Nebr.

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Ulsch, Nowlan M. (1937) Asst. Supt., Street Cleaning, Garbage Collection & Disposal Dept., 5th & Cleveland Sts., Jacksonville, Fla.

Upham, Charles (1926) Secy. & Engr.-Director, Am. Road Builders Assn., Natl. Press Bldg., Washington, D. C.

Vagtborg, Harold (1936) Assoc. Prof. Sanitary & Municipal Eng., & Assoc. Director, Research Foundation, Armour Institute of Technology, 3300 Federal St., Chicago, Ill.

Van Trump, Isaac (1911) Director, Van Trump Testing Lab., 2337 S. Paulina St., Chicago, Ill. & Terminal Warehouse Bldg., Little Rock, Ark.

Varney, Henry A. (1916) Town Engr., 25 Town Hall, Brookline, Mass.

Veatch, N. T. (Jr.) (1920) Black & Veatch, Cons. Engrs., 4706 Broadway, Kansas City, Mo.

Vedder, Arthur L. (1937) Secy., Planning Bd., Dept. of Public Works, 52 City Hall, Rochester, N. Y.

Veitch, Wm. M. (1932) City Engr., City Hall, London, Ontario, Can.

Vincenz, Jean L. (1936) Comr. Public Works & City Engr., City Hall, Fresno, Calif.

von Phul, William (1911) Pres., Ford, Bacon & Davis, Inc., 39 Broadway, New York, N. Y.

Von Zuben, F. J. (1912) Cons. & Supervising Engr., 1013-14 Electric Bldg., Fort Worth, Tex.

Vorhees, William V. (1932) 1st Asst. Surveyor, Bureau of Eng., Surveys & Zoning, 1152 Sanger St., Philadelphia, Pa.

Wagener, A. H. (1937) Chief of Construction, Dept. of Public Works, 54 Court St., Rochester, N. Y.

Wagner, C. F. (1923) Chief Engr., J. B. McCrary Co., 22 Marietta St. Bldg., Atlanta, Ga.

Wagner, Gerald J. (1919) Cons. Engr., Pres., G. J. Wagner & Co., 319-22 Tower Clock Bldg., Grand Rapids, Mich.

Waite, Henry M. (1935) NYA, Quaddy Village, Eastport, Me.

Walker, E. H. (1937) Structural Designer, City Engr's. Office, City Hall Annex, Rochester, N. Y.

Walker, Isaac S. (1923) Cons. Engr., 1208 Harrison St., Frankford, Philadelphia, Pa.

Walker, Stanton (1926) Director of Eng., Natl. Sand & Gravel Assn., Munsey Bldg., Washington, D. C.

Wallingford, Clyde E. (1935) City Mgr., (Covington, Ky.), 1134 Carmania Ave., Price Hill, Cincinnati, Ohio.

Walter, Albert G. (1922) City Engr., City Hall, Dunkirk, N. Y.

Walter Motor Truck Company (Assoc.-1926) 1001-1019 Irving Ave., Ridgewood, Queens, L. I., N. Y.

Ward, James E. (1933) Asst. Highway Engr., Ill. Div. of Highways, Construction Dept., Centennial Bldg., Springfield, Ill.

Warren, George C. (Senior-1901) Director, Executive Committee, Warren Bros. Co., P. O. Box 1869, Boston, Mass.

Warren, Ralph L. (Senior-1905) Vice-Pres., Treas. & Director, Warren Bros. Co., P. O. Box 1869, Boston, Mass.

Watson, H. Wallace (1931) Senior Surveyor, 10th Dist., Bureau of Eng., Surveys & Zoning, 1059 Allengrove St., Frankford, Philadelphia, Pa.

Weaver, Joseph F. (1930) City Engr., 2017 County St., Portsmouth, Va.

Weaver, Stuart M. (1937) Executive Asst. to Director of Public Works, & Supt. of Water Bureau, City Hall, Montclair, N. J.

Webb, Curtis C. (Assoc.-1937) Director, Municipal Research & Service, 200 City Hall, Louisville, Ky.

Webb, J. D. (1934) City Engr., City Hall, Birmingham, Ala.

Weber, B. B. (1917) City Engr., City Hall, Oil City, Pa.

Welch, Thomas H. (1937) Supervisor Garbage Reduction, City Hall, Schenectady, N. Y.

Weller, W. Earl (1937) Director, Rochester Bureau of Municipal Research, 45 Exchange St., Rochester, N. Y.

Weston, Robert Spurr (1914) Cons. Engr., Weston & Sampson, 14 Beacon St., Boston, Mass.

Wheeler, Walter M. (1936) City Engr., City Hall, Grand Island, Nebr.

White, Linn (1908) Cons. Engr., Chicago Park District, Administration Bldg., Burnham Park, Chicago, Ill.

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Whitney, Charles S. (1929) Cons. Engr., 724 E. Mason St. Milwaukee, Wis.
Whitsit, Lawrence C. (1936) City Engr., 30 Gerald Ave., Highland Park, Mich.
Wightman, C. R. (1937) Director of Public Works, City Hall, Benton Harbor, Mich.
Williams, A. C. (1936) Director Public Works, Haverford Twnp., 2325 Darby Rd., Oakmont, Dela. County, Pa.
Williams, J. A. (Assoc.-1910) Vice-Pres., Saint Mary's Sewer Pipe Co., Saint Mary's, Pa.
Williams, James A. (1937) Supt. of Public Works, Village Hall, Glencoe, Ill.
Williams, Stuart R. (1937) Mgr., Street Lighting Dept., Holophane Co., Inc., Newark, Ohio.
Williams, Thomas W. (1938) City Engineer, Municipal Bldg., New Bedford, Mass.
Willigerod, W. D. (1913) City Engr., City Hall, East Orange, N. J.
Wilson, H. Lee (1936) City Engr., City Hall, Johnstown, Pa.
Wilson, Joseph Hull (1936) Engr., Solvay Sales Corp., 800 5th St., Canton, Ohio.
Winship, Wilbur H. (1930) Asst. Supt., Dept. of Sanitation, 1020 Sanders St., Indianapolis, Ind.
Wise, B. A. (1916) Bradford, Pa.
Wolfe, Thomas F. (1924) Research Engr., Cast Iron Pipe Research Assn., 122 S. Michigan Ave., Chicago, Ill.
Wolfinger, Wellington R. (1918) Contractor & Engr., Curren Terrace, Norristown, Pa.
Wolman, Abel (1921) Chief Engr., State Dept. of Health, & Chairman, National Water Resources Com., Prof., Sanitary Eng., Johns Hopkins University, 2411 N. Charles St., Baltimore, Md.
Wood, E. A. (1927) Street Cleaning & Scavenging Div., Dept. of Health, City Hall Annex, Winnipeg, Manitoba, Can.
Wood, Gar, Industries, Inc. (Assoc.-1928) 7924 Riopelle St., Detroit, Mich.
Wood, L. A. S. (Assoc.-1921) Chief Lighting Engr., Westinghouse Electric & Mfg. Co., 1216 W. 58th St., Cleveland, Ohio.
Wrenn, Lewis M. (1935) City Engr., City Hall, Pontiac, Mich.
Wyler, Albert G. (1937) Principal Asst. City Engr., City Hall, New Orleans, La.
Wynne, J. Paul (1935) Supt. of Maintenance & Operation, City Hall, Binghamton, N. Y.
Xanten, William Albert (1936) Supervisor, City Refuse Div., Eng. Dept., District Bldg., Washington, D. C.
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■

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Mobile—Fisher, Harry L., City Engr., City Hall.
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Garrett, Roy Stuart, Asst. City Engr., City Hall.

ARKANSAS

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CALIFORNIA

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COLORADO

Grand Junction—Ratcliffe, Robert C., Chief, Dept. Public Works, City Hall.

CONNECTICUT

Hartford—Peck, Leon F., Supt. of Streets, & Supt. Highways, Metropolitan District, Hartford County, Municipal Bldg.
South Norwalk—Jennings, Irving C., Pres., Nash Eng. Co.

DELAWARE

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Gundlach, George C., Dist. Office, Bureau of Agricultural Eng., P. O. Box 755.
Heil, Julius P., Pres., The Heil Co.
Hibbard, F. Gardiner, Asst. Engr. of Way & Structures, Milwaukee Electric Railway & Light Co., 423 Public Service Bldg.
Knebes, E. L., Asst. City Engr., Room 407, City Hall.
Krohne, Arthur D., 176 S. 66th St.
Schwada, Joseph P., City Engr., City Hall.
Townsend, Darwin W., Cons. Engr., Consoer, Townsend & Quinlan, 757 N. Broadway.
Whitney, Charles S., Cons. Engr., 724 E. Mason St.
Racine—Gearen, M. C., Bridge Engr., Dept. of Public Works, 300 Cliff Ave.
Peirce, Walter A., Mgr., Water Dept., City Hall.
Sheboygan—Boley, Arthur L., City Engr., City Hall.
Donohue, Jerry, Pres., Jerry Donohue Eng. Co., 608 N. 8th St.
Stevens Point—Jackson, M. D., City Engr., 213 N. 2nd St.
West Allis—Darby, William D., City Engr., City Hall.

ARGENTINA

La Plata—Grisi, Adolfo P., Jefe, Estudios y Projectos, Direccion de Pavimentacion, M. O. P., Bcia Buenos Aires.
Magliano, Hilario (Dr.) Decano de la Facultad de Ciencias Fisicomatematics, Calle 47, esquinas 1.

BRAZIL

Rio de Janeiro—Rangel, L. A. de Souza, Chief Engr., Dept. of Public Works, Rua Buenos Ayres, No. 93-3 andar.
Sao Paulo—Silva Freire, Victor da, Pres., Humus Ltd. Sewerage & Sanitary Developments, Caixa 18.

ALBERTA, CANADA

Edmonton—Haddow, A. W., City Engr., City Hall.

MANITOBA, CANADA

Winnipeg—Aldridge, William, Asst. City Engr., 333 McGee St.
Wood, E. A., Street Cleaning & Scavenging Div., Dept. of Health, City Hall Annex.

NOVA SCOTIA, CANADA

Halifax—Johnston, H. W., City Engr., City Hall.
Truro—Gordon, Murray L., Town Engr., Box 95.

ONTARIO, CANADA

Hamilton—Brennan, W. C., Pres., Brennan Paving Co., Ltd., 400 Gage Ave., North.
McFaul, William Lawrence, City Engr. & Mgr. Water Works, City Hall.
London—Veitch, Wm. M., City Engr., City Hall.
Renfrew—Stewart, John R., Town Engr., Box 447.
St. Catharines—Lamson, B. F., City Engr., City Hall.
St. Thomas—Miller, W. C., City Engr. & Treas., City Hall.
Stratford—Riehl, W. H., City Engr., City Hall.
Toronto—Bradley, Harold D., Street Comr., 90 Albert St.
Harris, R. C., Comr. of Works, City Hall.
Macallum, Andrew F., 108 Avenue Rd.
Storrie, William, Cons. Civil Engr., Gore & Storrie, 1130 Bay St.
Taylor, G. E., Deputy Street Comr., 90 Albert St.

QUEBEC, CANADA

Montreal—Boucher, Pierre, Secy., Dept. of Planning & Research, Montreal Metropolitan Com., 10 St. James St. W.
Parent, Arthur, Consultant to City Electrical Dept., 4935 Queen Mary Rd.
Verdun—Hadley, Henry, City Engr., City Hall.

ENGLAND

London—Dawes, J. C., Ministry of Health, Whitehall S. W. 1.

GERMANY

Frankfurt-am-Main—Schroeder, A., Weidenbornstrasse 40.

HAWAII

Honolulu—Ohrt, Frederick, Mgr. & Chief Engr., Bd. of Water Supply, P. O. Box 3347.
Rush, Benjamin F., Chief Engr., Dept. Public Works, City Hall.

HUNGARY

Budapest—Ballo, Alfred (Dr.) Director, Dept. of Public Cleansing.

JAPAN

Osaka—Shimoda, Yoshito (Dr.) Director, Osaka Municipal Hygienic Lab.

NEWFOUNDLAND

St. Johns—Mahony, J. J., City Clerk.

NEW ZEALAND

Rawene—Donnelley, L. S., Engr., Hokianga County, P. O. Box 3.

VENEZUELA

Caracas—Guardia, Carlos Alberto, Ingeniero Sanitario, Ministerio de Sanidad, Apartado 1175.

PROFESSIONAL AND COMMERCIAL ANNOUNCEMENTS

Professional and Commercial Announcements

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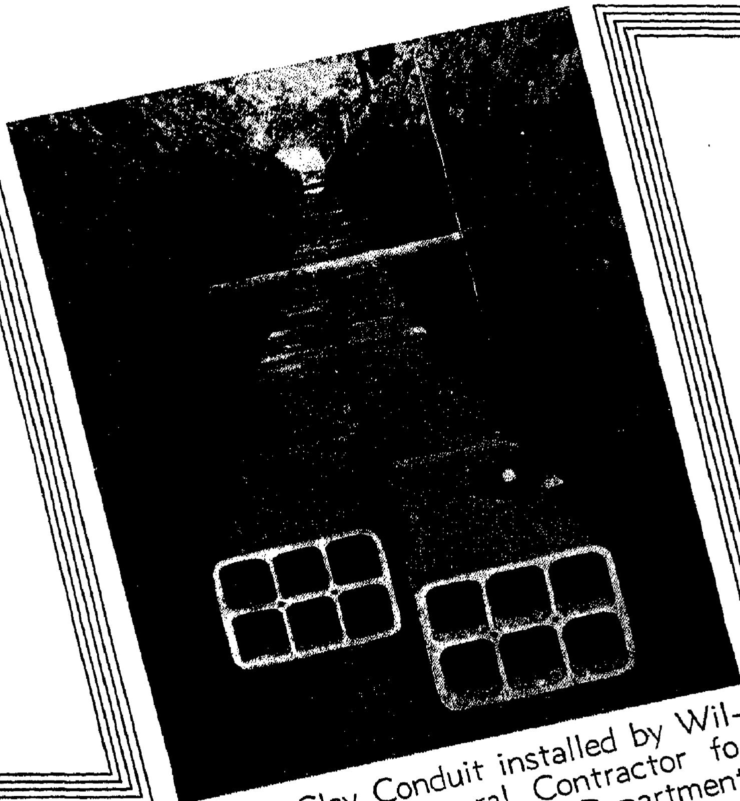

Natco Clay Conduit installed by William Dipple, General Contractor for City of New York Fire Department, Woodhaven, L. I.

Natco Underground Clay Conduit protects cables against fire, corrosion, vibration, electrolysis, mechanical injury or interference and chemical attack. It possesses high compressive strength, wet or dry, with a very low coefficient of expansion. Natco Clay Conduit is made in shapes suitable for high or low tension power cables for fire and police alarm telegraph systems, state, institutional and municipal light and power plants, air ports and similar installations.

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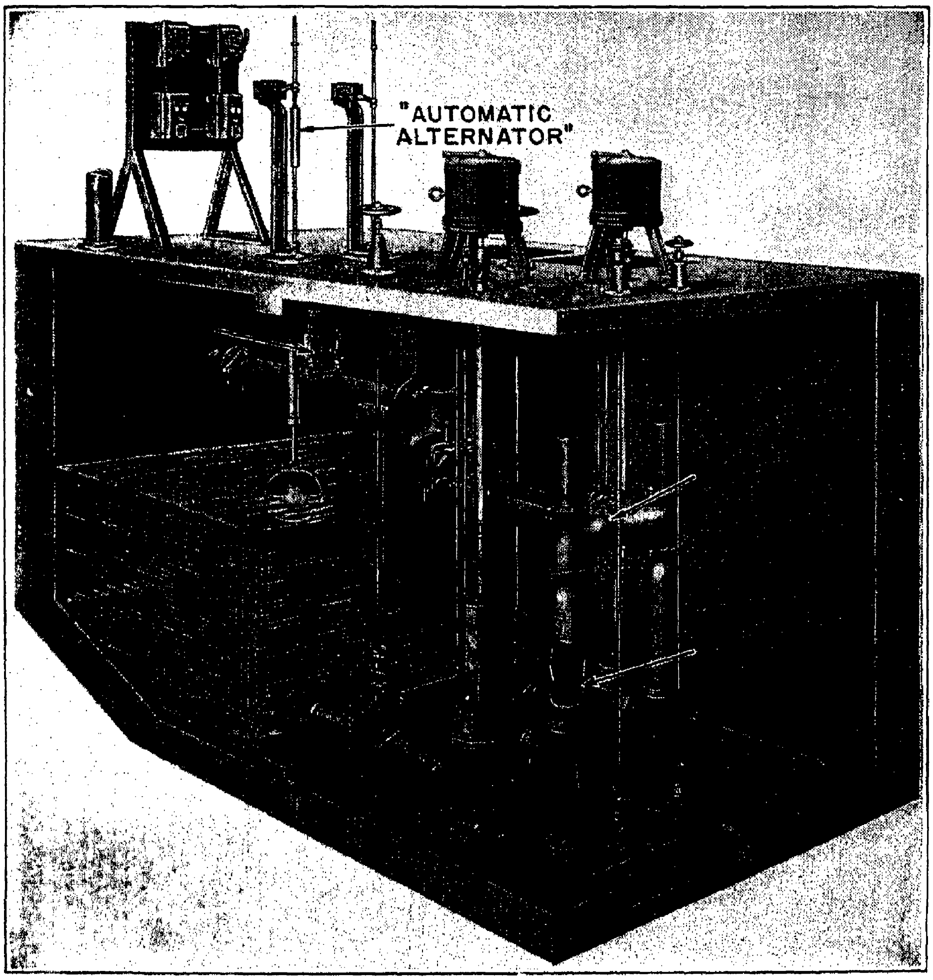

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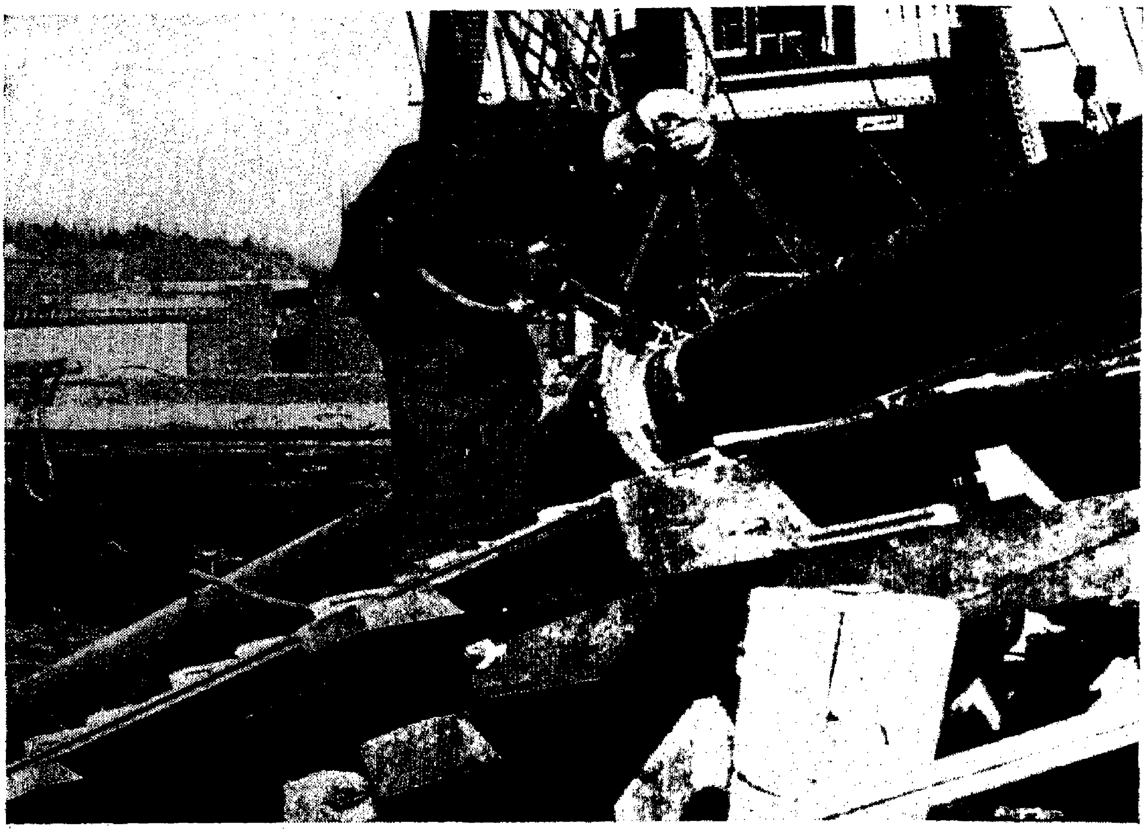

Installing flexible joint cast iron pipe for line crossing inlet at Seabright, New Jersey

CONCRETE PIPE SEWERS

YOU will be interested to know that concrete pipe has been used for building sanitary and combined sewers since the dawn (1847) of sanitary engineering, as it is practiced today. The oldest concrete pipe sanitary sewer of record was built in Mohawk, N. Y. in 1842—96 years ago. Concrete pipe has been used for sanitary sewers since 1867 in Hudson, N. Y.; 1868 in Bay City, Mich.; 1868 in Nashua, N. H.; 1874 in North Adams, Mass.; 1881 in North Manchester, Ind.; 1883 in Racine, Wis.; 1889 in Louisville, Ky.; and 1889 in South Bend, Ind.

The vast expenditures for concrete sewers of all sizes are the natural result of the performance of these early pipe lines. The Sanitary District of Chicago alone has expended more than $42,000,000 for concrete sanitary sewers; Detroit, Mich. more than $60,000,000, including concrete pipe lateral sewers. Louisville, Ky., is completing a $17,000,000 concrete sewerage system today. The River Des Peres sewers in St. Louis, 29 and 32 ft. in diameter, which cost more than $11,000,000 were built with concrete; Baltimore's 7-mile, 12-ft. outfall concrete sanitary sewer was built in 1908 and placed in service in 1911. When examined in 1931, after 20 years of service, the concrete was stronger than when built (*Engineering News-Record,* May 19, 1932).

Sewage treatment plants, outfall, intercepting and lateral sewers, costing vast sums of money, are built with concrete. Sewers in the steel plants of Gary, Ind., and the Pittsburgh district of Pennsylvania are built with concrete. Portland cement mortar is used in brick masonry; for clay segment block sewers, as well as for joints in clay pipe sewers. In other words, concrete is used today in every type of sewer and has been so used since sewers were built in this country and abroad.

American Concrete Pipe Association
33 West Grand Avenue · Chicago, Illinois

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